Conceptual Habitat Restoration and Adaptive Management Plan

BALLONA WETLANDS ECOLOGICAL RESERVE
MARINA DEL REY, LOS ANGELES COUNTY, CALIFORNIA

Prepared For:

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LIST OF ACRONYMS

BWER	Ballona Wetlands Ecological Reserve
CDFG	California Department of Fish and Game (now California Department of Fish and Wildlife)
CDFW	California Department of Fish and Wildlife (formerly California Department of Fish and Game)
CEQA	California Environmental Quality Act
CNPS	California Native Plant Society
Conceptual Plan	Ballona Wetlands Ecological Reserve Conceptual Habitat Restoration and Adaptive Management Plan
Corps	U.S. Army Corps of Engineers
GIS	Geographic Information System
HMMP	Habitat Mitigation and Monitoring Plan
msl	Mean sea level
NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
PAR	Property Analysis Record
PMT	Project Management Team
PWA	Phillip Williams and Associates
Reserve	Ballona Wetlands Ecological Reserve
SCC	California State Coastal Conservancy
SLC	California State Lands Commission
SMBRC	Santa Monica Bay Restoration Commission
USFWS	U.S. Fish and Wildlife Service

1.0 INTRODUCTION

This Conceptual Habitat Restoration and Adaptive Management Plan ("Conceptual Plan") presents conceptual guidelines for biological components of habitat restoration within the Ballona Wetlands Ecological Reserve ("BWER" or "Reserve") using principals of adaptive management. The purpose of this document is to provide a conceptual outline of the restoration from a habitat perspective and guide the development of more detailed elements of the restoration such as the final grading plan, the planting/landscape plan, the operations and maintenance plan/long-term management plan, and the habitat mitigation and monitoring plan ("HMMP"). The final design and implementation of the proposed restoration at the BWER will be informed by the biological components presented here as well as the hydrological and geomorphological design components developed by ESA PWA (2011a-d, 2012a-c) and will be refined through the associated California Environmental Quality Act ("CEQA") and National Environmental Policy Act ("NEPA") analysis and regulatory agency permitting for the project.

The information presented in this document is based on an extensive body of previous research and planning documents and represents input from a large team of scientists, engineers, conservation planners, and regulators. Where possible, clear direction is given on how activities will proceed; however, in some cases, not enough information is available to make a decision at this point. For these cases, we purposefully use "should" rather than "shall" or "will" to show the intended uncertainty.

The project aims to restore one of the largest remaining tracts of tidal marsh in southern California and is of particular significance considering that coastal wetlands in Los Angeles County have been reduced upward of 96 percent relative to pre-development conditions (PWA et al. 2006). The land, approximately 600 acres (242 hectares) of an original 2,000-acre (809 hectares) tidal marsh in Los Angeles County, is jointly owned by the California Department of Fish and Wildlife ("CDFW"; formerly the California Department of Fish and Game, "CDFG") and the California State Lands Commission ("SLC"). The CDFW, the SLC, the California State Coastal Conservancy ("SCC"), and the Santa Monica Bay Restoration Commission ("SMBRC") are working together to develop the restoration with the following overarching goals:

> *Restore, enhance, and create estuarine habitat and processes in the Ballona Ecosystem to support a natural range of habitat functions, especially as related to estuarine dependent plants and animals.*

Create opportunities for aesthetic, cultural, recreational, research, and educational use of the Ballona ecosystem that are compatible with the environmentally sensitive resources of the area.

The proposed restoration aims to reestablish a once vibrant tidal wetland system, increasing the ecosystem function and flood protection values of this degraded site. The restored wetlands will feature a mosaic of tidal wetland, dune, scrub, and grassland habitats with numerous opportunities for public enjoyment and education.

1.1 Restoration Background

The BWER site consists of approximately 600 acres (242 hectares) of open space in the Marina del Rey area of Los Angeles, in Los Angeles County, California (Figure 1). Of these 600 acres (242 hectares), 540 acres (218 hectares) are owned by the CDFW and 60 acres (24 hectares) are owned by the SLC. The 60 acres (24 hectares) belonging to the SLC was leased to the CDFW and the entire property was named the Ballona Wetlands Ecological Reserve. Funds for the purchase were acquired from Proposition 12 which set aside $300 million for coastal wetland acquisition and restoration in southern California. Funds for the planning and restoration of the property were also provided by Proposition 12. Together, the CDFW, SLC, and SCC are working with stakeholders, scientists, and other agencies to restore the wetlands.

1.2 Restoration Goals and Objectives

Goals developed for the restoration include the following:

Restore, enhance, and create estuarine and associated habitats and processes to support a natural range of habitat structures and functions in the Reserve.

Establish processes and functions within the Reserve to support estuarine habitats by improving tidal circulation into the wetlands to enlarge the amount of area that is tidally inundated, increase tidal prism and excursion, lower residence time of tidal water, ensure a more natural salinity gradient, and create a dynamic interaction between Ballona Creek, Ballona Wetlands, and the Santa Monica Bay.

Create a self-sustaining estuarine system by providing large, contiguous areas of diverse intertidal wetland habitat with wide transition and buffer areas to allow for adaptation to sea level rise, minimize the need for active management, and reduce negative impacts associated with human activities and invasive species.

Figure 1. Location Map

Ballona Wetlands Ecological Reserve
Conceptual Restoration and Adaptive Management Plan
Marina Del Rey, California

N W E S

0 0.25 0.5 1 1.5 2
Miles

wra
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Map Date: February 2013
Map By: Derek Chan
Base Source: ESRI/National Geographic

Path: L:\Acad 2000 Files\00000\00016-3\gis\arcmap\Management Plan\Fig1_LocMap_20130220.mxd

Provide landscape-level functions sustaining the multiple levels of biodiversity associated with estuarine systems by strategically preserving, restoring, enhancing, and developing multiple habitats and incorporating transitional and upland habitat links to the wetlands to support recruitment and the various life stages of a diverse native flora and fauna.

Establish a restored estuarine system that protects and respects cultural and sacred resources, enables cultural use of the site by Native Americans, and provides appropriate interpretive information about prior uses of the site.

Develop and enhance public access, recreation, environmental education, and interpretation opportunities within the Reserve through the development of appropriate visitor facilities and connections to regional and local trail networks.

Protect existing and planned roadways, utilities, and adjacent properties and uses by maintaining or improving flood protection and stormwater management, ensuring consistency with future regional plans, and limiting the need for significant modification to regionally important infrastructure.

Ensure public safety, resources protection, and security while minimizing security and maintenance costs by facilitating adequate law enforcement, providing for safe traffic movement and parking, reducing hazards, and providing appropriate access.

Ecological objectives include creating, restoring, and enhancing wetland and upland habitats in the Reserve to both increase and improve habitat for tidal wetland plant and wildlife species and to improve ecological services such as flood control and water quality improvement. Cultural objectives include protection of Native American cultural resources within the Reserve. Public access objectives include preserving and increasing public access to the Reserve in a manner compatible with sensitive habitats and special-status species. Public education objectives include increasing awareness of the value of wetland systems and increasing public involvement in the protection and restoration of sensitive habitats and the protection of special-status plants and animals. The goals and objectives presented above have been further refined during the development of this Conceptual Plan. These objectives are discussed in more detail in the following sections.

It should be noted that the proposed restoration includes elements of both habitat *restoration* and habitat *creation*. Our understanding of the historical ecology of the Ballona region is largely inferred from historical accounts of the Los Angeles coast (e.g., Dark et al. 2011); few hard data exist regarding historical habitat composition or ecosystem function at the BWER. Moreover, development within the Ballona Creek watershed and the associated need for flood control greatly limit the options available for restoration. Some aspects of the restoration plan involve “restoration” in the sense of recovering historical conditions. However, most aspects of the restoration plan involve reestablishment of natural processes and ecological functions and either habitat creation (i.e., creating a particular type of habitat where it previously did not exist) or habitat enhancement (i.e., modification of existing conditions). However, to avoid over-complicating the Conceptual Plan, the term “restoration” is used throughout the text and is meant to encompass all of these elements and not only the re-creation of a historical condition.

1.2.1 Habitat Objectives

The restoration will improve the quality and diversity of native plant communities within the Reserve. An appropriate mix of upland and wetland plant communities will be necessary to maintain or increase numbers of special-status plant species and to maintain or increase use of the Reserve by special-status wildlife species. The specific focus for upland habitats will be on the preservation and enhancement of dunes; however, enhancing grassland and coastal scrub will also be important. The specific focus for wetland habitats will be on increasing and enhancing tidal marsh habitat. Improving freshwater wetlands and riparian habitat will also be addressed. In addition to improving habitat for special-status plant and wildlife species, native plant abundance and diversity will be increased throughout the Reserve.

Impacts from invasive species will be minimized throughout the Reserve. Complete eradication is not achievable, and efforts to control invasive species will be prioritized based on the level of threat posed to sensitive habitats and special-status plant and wildlife species. Preventative measures will be taken to ensure that disturbance during construction does not increase levels of invasive species at the Reserve.

1.2.2 Wildlife Objectives

The restoration will improve overall habitat quality for native wildlife species, with the goal of increasing abundance and diversity of native animals that use the Reserve. The specific focus will be on improving habitat for wildlife species associated with tidal wetland habitat, including birds, fish, and benthic invertebrates. Non-native urban predators will be controlled to allow populations of native wildlife species to expand and occupy newly restored habitat. Similarly, human- and pet-related disturbances will be minimized throughout the Reserve to encourage use by sensitive wildlife species.

1.2.3 Special-Status Species Objectives

The restoration will preserve and enhance habitat for special-status plant and wildlife species that currently occur in or make use of the Reserve. The establishment of additional populations of special-status species will be encouraged. Potential disturbances to sensitive habitats or wildlife species will be reduced through effective design of public access areas, predator management, and other management tools.

1.2.4 Cultural Resource Objectives

To the extent feasible, cultural resources within the Reserve will be avoided by project construction and will be protected. The approach for avoiding and protecting cultural resources will be outlined in the cultural resources report to be prepared for the project.

1.2.5 Public Access, Education, and Involvement Objectives

Levels of public access to the Reserve will be maintained or increased. Public access will be limited to uses compatible with plant and wildlife resources in the Reserve, and special care will be taken to avoid impacts to sensitive habitats or special-status plant and wildlife species. Exclusion from some areas will be necessary to achieve this goal. Opportunities for public awareness and education will be provided through the use of interpretive signs, viewing areas, and other means. To the extent practical, public involvement will be encouraged during the restoration, monitoring, and long-term management of the BWER.

1.2.6 Flood Control and Ecological Service Objectives

The restoration will maintain or increase existing levels of flood protection and water quality improvement functions provided by wetlands in the Reserve. Increasing tidal input to the wetlands as well as increasing the overall acreage of wetlands within the Reserve will increase the capacity of the wetlands to absorb floodwaters. Increasing the acreage and overall quality of wetlands within the Reserve will increase the water quality improvement functions of the wetlands. Improvements to Ballona Creek will help reduce scour and additional sediment loading.

1.3 Purpose of the Conceptual Plan

The purpose of this Conceptual Plan is to provide conceptual guidelines for the long-term restoration and management of the BWER using adaptive management practices to preserve and enhance the ecological and social values of the Reserve. The Conceptual Plan focuses primarily on the biological component of the restoration design and implementation. The geotechnical components of the design and implementation have been addressed in numerous technical documents produced by ESA PWA, Phillip

Williams and Associates ("PWA"), Psomas and Associates, and Group Delta Consultants, Inc. (ESA PWA 2011a-d, 2012a-c; PWA 2008, 2010; PWA et al. 2006). Together, the biological and geotechnical components will be used to guide the overall design and implementation of the restoration. Specifically, this Conceptual Plan serves to:

> *Provide an overview of the Reserve, including its relevant physical, ecological, and biological features and processes, and cultural values.*
>
> *Provide a description of physical structure and biological composition of target habitats which will serve to guide the restoration.*
>
> *Provide the framework for developing a detailed monitoring and adaptive management plan to be implemented at the Reserve.*

The Conceptual Plan provides the framework for achieving the goals and objectives discussed above in Section 1.2. The Conceptual Plan includes an overview of the restoration process which highlights pertinent environmental, ecological, and cultural issues. The Conceptual Plan also includes a monitoring program and adaptive management framework designed to guide the development of a more detailed Monitoring and Adaptive Management Plan.

1.4 Overview of Adaptive Management Practices

The restoration and long-term management of the Reserve will be based on principles of adaptive management. Adaptive management is an iterative process whereby restoration practices are guided by best available technologies and hypothesis testing followed by implementation and monitoring to evaluate results. This approach allows for restoration and management under changing conditions and with uncertainties in the course of habitat development. Adaptive management involves six primary steps: (1) research and planning, (2) design, (3) implementation, (4) monitoring, (5) evaluation, and (6) modification or adaptation. Most importantly, adaptive management is a reflective process in which management actions are continuously monitored and evaluated and necessary changes in management are planned and implemented, followed by continued monitoring and evaluation.

For a more detailed discussion of adaptive management see Atkinson et al. (2004) or Fischenich et al. (2011).

2.0 SUMMARY OF EXISTING CONDITIONS

Existing conditions and baseline ecological data at the BWER have been extensively documented (e.g., PWA et al. 2006; Johnston et al. 2011, 2012). The following sections summarize existing conditions at the BWER to provide context for the restoration and this Conceptual Plan.

2.1 Property Description

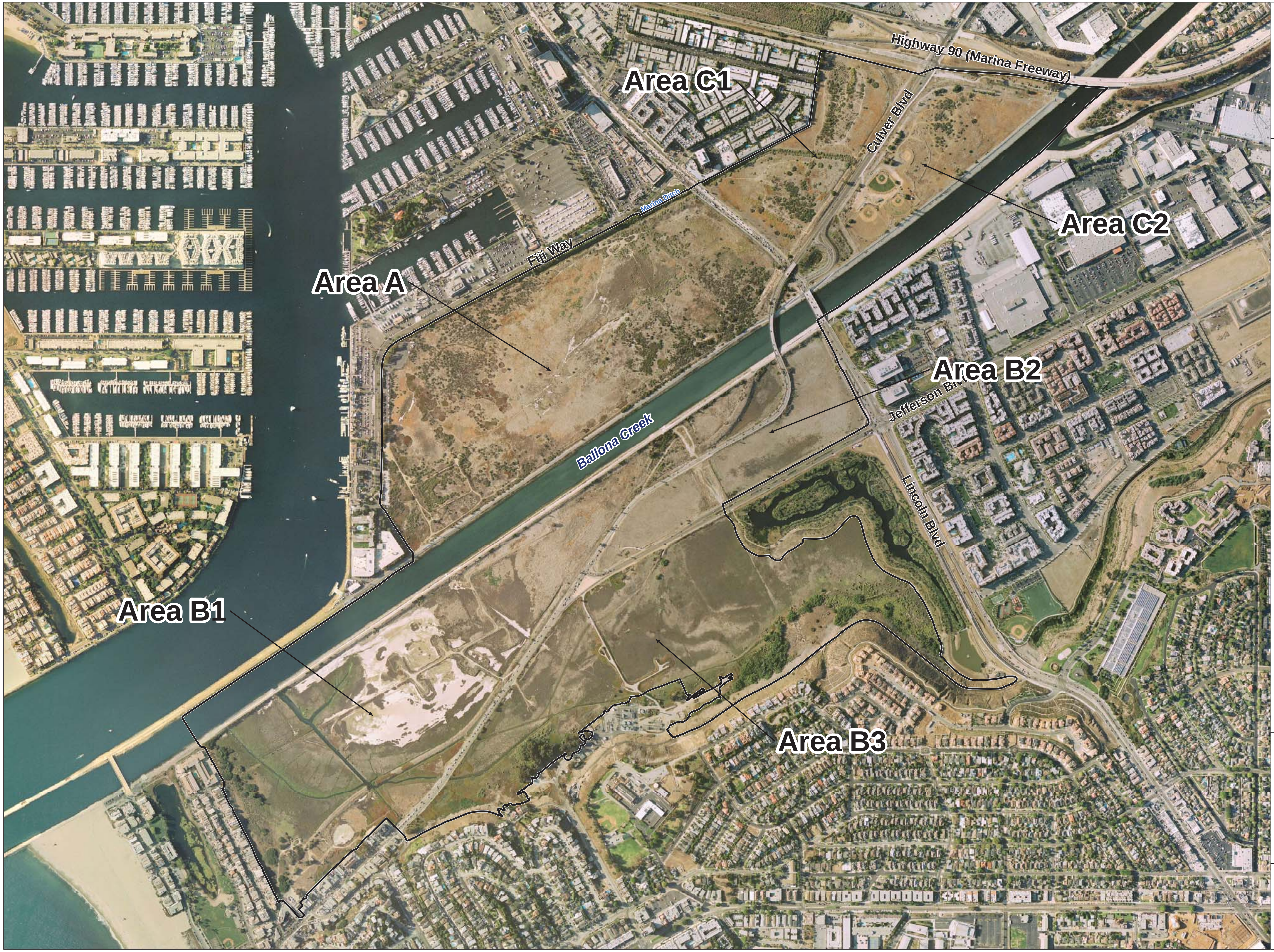
2.1.1 Geographical Setting and Site Overview

The Reserve is located in coastal Los Angeles County, California (Figure 1). The site is located northwest of Los Angeles International Airport, near the Marina del Rey area. The Reserve can be accessed by four major roads intersecting or abutting the site: Lincoln Boulevard, Jefferson Boulevard, Fiji Way, and Culver Boulevard. The Reserve is bisected by Ballona Creek and is generally discussed as three areas (A, B, and C; Figure 2). Area A lies north of Ballona Creek, west of Lincoln Boulevard, and south of Fiji Way. Area B lies south of Ballona Creek, west of Lincoln Boulevard, and north of Cabora Drive; the area is bounded on its western side by dunes bordering homes along Vista del Mar. Area C is bounded by Ballona Creek, the Marina Expressway, Lincoln Boulevard, and mixed-use development between the Expressway and Lincoln Boulevard.

The BWER comprises approximately 600 acres (242 hectares) of which 540 acres (218 hectares) are owned by the CDFW and 60 acres (24 hectares) are owned by the SLC. Of the 60 acres (24 hectares) owned by the SLC, 24 acres (10 hectares) , known as the Expanded Wetlands Parcel, are operated by the CDFW and are covered by this Conceptual Plan. The remaining 36 acres of SLC property, known as the Freshwater Marsh, are managed by the Ballona Wetlands Conservancy under a separate conservation easement and are not covered under this plan. Adjacent land use is primarily residential with some commercial development and institutional/government use. Land use adjacent to Area A is dominated by Marina del Rey which is one of the largest small craft harbors in the world and is the source of the majority of the fill material historically placed in Area A.

2.1.2 Cultural Features

A detailed discussion of cultural resources at the BWER is provided in the Existing Conditions Report for the Ballona Wetlands (PWA et al. 2006) and the Archaeological Survey Report (ICF International 2011). Cultural resources at the BWER will be preserved to the extent practicable during the restoration; for Native American resources, this will be done in consultation with the appropriate tribe. Details regarding



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Ballona Wetlands Ecological Reserve Conceptual Restoration and Adaptive Management Plan

Marina Del Rey, California

Figure 2.

Site Overview

Map Date: August 2011
Map By: Sundaran Gillespie
Base Source: County of LA
Filepath: L:\Acad 2000 Files\00000\00016-3\gis\arcmap \Management Plan\Fig2_SiteOverview_20130220.mxd

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cultural resources at the site and the approach to protecting such resources during the restoration can be found in the Archaeological Survey Report (ICF International 2011).

2.1.3 Existing Infrastructure

Various transportation, utility, and flood control infrastructure elements currently exist on the BWER property. Some of these elements will be left in place or modified as part of the proposed restoration. Other infrastructure elements will need to be removed to accommodate restoration efforts. In addition, new infrastructure will be created such as a visitor center, parking areas, pedestrian paths, lighting, fencing, and related elements. Members of the project management team ("PMT") have met with agencies, businesses, and organizations that have an interest in infrastructural elements within and adjacent to the BWER to discuss future infrastructure plans under the proposed restoration. Detailed descriptions of existing infrastructure can be found in the *Preferred Alternatives Memorandum* (PWA 2010) and the *Existing Conditions Report* (PWA et al. 2006).

2.2 Environmental and Ecological Description

The information provided in the following sections comes from a range of sources including the existing conditions report (PWA et al. 2006), the baseline conditions study (Johnston et al. 2011, 2012), and other sources. This information is intended to provide a contextual background for the other elements of this report.

2.2.1 Regional Climate

Southern California experiences a Mediterranean climate with moderate seasonal temperature fluctuation influenced by the Pacific Ocean and seasonal precipitation occurring predominantly in the winter and spring. The BWER experiences mild year-round temperatures with an average summer temperature of 69 degrees Fahrenheit (21 degrees Celsius) and an average winter temperature of 57 degrees Fahrenheit (14 degrees Celsius), with seasonal coastal fog and an average winter precipitation of 8.26 inches (20.98 centimeters).

2.2.2 Historical Ecology

The historical extent of the Ballona Lagoon is estimated to range from 2,120 acres (858 hectares) (PWA et al. 2006) to 4,288 acres (1735 hectares) (Dark et al. 2011). The Lagoon was part of the larger Ballona Creek watershed which historically covered a large swath of western Los Angeles from the Santa Monica Mountains to the coast (Dark et al. 2011). Natural shifts in the flows of the Los Angeles River and the subsequent channelization of the River in the 1880s resulted in Ballona Lagoon transitioning from an expansive wetland complex at the terminus of the Los Angeles River watershed to a more discrete wetland associated with the smaller Ballona Creek watershed (Dark et al. 2011; Ambrose and Bear 2012). This shift in the hydrologic regime of the Ballona region was further intensified by subsequent flood control efforts and commercial development in the area up through the early 2000s (Dark et al. 2011; PWA et al. 2006), the most important of these being the installation of flood control structures along Ballona Creek in the 1930s (Ambrose and Bear 2012; PWA et al. 2006).

Identification of dominant historical vegetation and habitats in the BWER is complicated by the lack of systematic surveys in the area prior to development. Focusing on the Ballona Creek watershed from approximately 1850 to 1890, Dark et al. (2011) determined that the BWER area was dominated by (in order from greatest to least extent) alkali meadows, tidal marsh, wet meadows, salt flats, willow thickets, beach and dune habitats, open water, and perennial freshwater ponds, with vernal pools occurring further inland. Species such as cordgrass (*Spartina* spp.), which are typically found in perennially open tidal wetlands (e.g., tidal channels and low marsh habitat), are not found in the older records. However, records indicate that species commonly associated with brackish, freshwater, dune, and salt marsh habitats were present (Dark et al. 2011). Ambrose and Bear (2012) determined that the habitat composition of the BWER shifted from being dominated by salt marsh and mudflats in 1876 to being dominated by grassland, coastal scrub, muted-tidal marsh, and non-tidal marsh habitats as occur today.

Mattoni and Longcore (1997) describe for an extensive Los Angeles coastal prairie extending from Playa Del Rey south to the Palos Verdes penninsula and extending inland to east of Torrance. Although the study focuses on the coastal headlands and does not specifically discuss the Ballona Lagoon, many of the annual prairie and vernal pool plant species they list would likely have occurred in the lowlands around the Ballona Wetlands where soil conditions were likely similar. Mattoni and Longcore developed a plant list for the Los Angeles coastal prairie based on herbaria records and historical literature, and the list shares marked similarities with characteristic southern coastal needlegrass grassland, southern coastal grassland, and pristine California grassland, with the coastal prairie list being differentiated by the presence of vernal pool-associated species. They concluded that the Los Angeles coastal prairie contained extensive vernal pool habitat based on historical topography and herbaria records, historical descriptions including photographs and place names, and identification of physical remnants of pools by the authors.

The lack of specific, systematic surveys of the historical BWER area makes it difficult to determine the historical composition of vegetation in the area. Mattoni and Longcore's list was compiled using herbaria records, historical records including amateur botanical collections and anecdotal accounts, habitat descriptions from early floras of southern California, and consultation with local botanists. However, the authors note that the only available source of quantitative data for the Los Angeles coastal prairie was a photograph taken in 1938 which was then compared to later photographs to measure species frequency and percent cover. Dark et al. (2011) discuss the Ballona Lagoon more specifically, but note that they, like Mattoni and Longcore, utilized a variety of sources including historical maps and surveys in combination with photographs, historical reports, herbaria records, and bird observations to draw their conclusions. Although Dark et al. (2011) provide a list of plants they believe were historically present in the Ballona Wetlands region, they do not draw conclusions as to likely dominant species or associations. Ambrose and Bear (2012) compared topographic maps (t-sheets) generated by a precursor of the National Oceanic and Atmospheric Administration ("NOAA") with a modern survey by the CDFW to determine the change in the extent and composition of habitat types at the Ballona Wetlands from 1876 to 2007; however, they do not discuss vegetation in detail.

The restoration plan for the BWER has been developed with consideration of the historical ecology of the BWER; however, given the lack of detailed knowledge regarding the historical ecology of the area and the major changes that have occurred within the watershed, restoration to historical conditions is not possible. Centuries of surrounding development and other major alterations to the watershed, the flood control requirements of the project, the habitat requirements of special-status wildlife and plant species currently at the site, and the funds available for restoration are all factors that influence the opportunities for restoration at the BWER.

2.2.3 Geology, Soils, and Hydrology

Bedrock geology in the vicinity of the Reserve is characterized by faulting and tectonic activity typical of southern California. The Charnock and Overland faults are the closest faults to the BWER, at 1.3 miles (2.1 kilometers) northwest and 2.5 miles (4 kilometers) northeast, respectively (PWA et al. 2006). Native soils at the BWER are of fluvial and marine origins and include a wide range of particle sizes and textures (PWA et al. 2006). Sand becomes a more prevalent constituent in the upper layers of the soil approaching the ocean-side of the Reserve. Native soils in Areas A and C are overlain at a depth of 0 to 18 feet (0 to 5.5 meters) by sediments dredged during the construction and maintenance of Marina del Rey and Ballona Creek (PWA et al. 2006). Soil testing has revealed high levels of a number of elements of concern throughout the Reserve, but particularly in the salt panne, tidal marsh, and freshwater habitats in the eastern portion of the Reserve and in illegally dumped fill soils in the northeastern portion of Area B. Elements of concern include boron, selenium, vanadium, zinc, copper, sulfur, and lead (PWA et al. 2006; Johnston et al. 2011). Additional investigations will be necessary to fully document the concentration and distribution of these elements throughout the Reserve and to determine whether remediation will be necessary.

Hydrology at the BWER is influenced by tidal action from Santa Monica Bay as well as groundwater, urban runoff, and stormwater from within the Ballona Creek watershed. Mixed semidiurnal tides bring two high and two low tides of unequal height each day which propagate through the mouth of Ballona Creek and Marina del Rey. Area A receives tidal inflow via a culvert connected to Marina del Rey. Area B receives muted tidal inflow via self-regulating tide-gates in Ballona Creek. The Ballona Creek watershed includes approximately 130 square miles (337 square kilometers) of largely urbanized land. The majority of the Ballona Creek drainage network occurs as storm drains, underground culverts, and concrete channels. Inflow from these sources is particularly important in the Freshwater Marsh located along Lincoln Avenue and in freshwater habitats in Area B. Groundwater from the Ballona Creek watershed is a particularly important source of inflow for the wetlands. Groundwater is present in both confined and unconfined water table aquifers under Area B, with water table levels ranging from 1 foot (0.3 meter) above mean sea level ("msl") to 2.0 feet (0.6 meter) below msl. Areas A and C do not receive major hydrologic input from groundwater discharge, although observations of a perched water table have been made in Area A. Groundwater recharge is largely through infiltration through the soil profile following rainfall and during inundation by surface water.

Descriptions of soils and hydrology for each area of the BWER are presented below. A more detailed accounting can be found in the Existing Conditions Report (PWA et al. 2006).

<u>Area A</u>

Area A has been almost entirely modified from its natural state by the placement of fill and dredged material from numerous projects including construction of the Pacific Electric Railroad levee, platforms created for oil production facilities, and dredging of Marina del Rey and Ballona Creek. The placement of fill material has resulted in wide variation in topography and the distribution of sediments throughout Area A. Fill material ranges in thickness from 9 to 18 feet (2.7 to 5.5 meters) in the western portion of Area A and to 0 feet (0 meters) in the eastern portion, within the Marina Ditch. Fill material is underlain by the original marsh soils comprised of silty clay and clay. Bore data indicate potential subsidence of the original marsh surface due to the placement of fill material, with the original surface ranging from 2 feet (0.6 meter) below msl to 4 feet (1.2 meters) above msl.

Historically the overall elevation was less than 5 feet (1.5 meters) above msl; it now ranges from a low of 9.3 feet (2.8 meters) above msl in an area 600 feet (183 meters) south of the intersection of Admiralty Way and Fiji Way to a high of about 17.4 feet (5.3 meters) above msl at the far western end of the site. Variations in topography and the composition and structure of fill materials have led to varied hydrological regimes throughout Area A. Water infiltrates through the soil profile or flows downslope in areas with steep topography and coarse fill material and tends to collect in low-lying areas with more fine-grained fill material. Surface drainage in Area A either ends up in numerous closed depressions or in Marina Ditch which runs along the northern boundary of the Reserve and is connected to Marina del Rey via culverts under Fiji Way. The majority of Area A drains into the former "stilling basin" in the center of the Area. Water inputs in Area A come from tidal action which is contained in the Marina Ditch and from precipitation. As such, ponding generally only occurs during the wet winter months, and Area A consists largely of upland habitat.

Area B

Area B was not filled as extensively as Areas A and C and retains much of its original topography. The area is bisected by several roads which greatly affect its hydrology and have resulted in four distinct wetland areas: (1) the north wetland located north of Culver Boulevard, south of Ballona Creek, and east of Playa del Rey; (2) the south wetland located north of Del Rey Bluffs, west of the Gas Company road, south of Culver Boulevard, and east of Playa del Rey; (3) the east wetland located north of Del Rey Bluffs, west of the Freshwater Marsh, south of Jefferson Boulevard, and east of the Gas Company road, including the alluvial fan at Hastings Canyon and the lower portions of the Del Rey Bluffs; and (4) the northeast wetland located north of Jefferson Boulevard, south of Ballona Creek, and east of the Gas Company road. Sediments in these areas are mostly fine-grained. The western portion of Area B is richer in sand whereas the eastern portion is rich in silt and clay. Detailed descriptions of the individual wetland areas are provided in the Existing Conditions Report (PWA et al. 2006).

Elevations in Area B range from 2.4 to 5 feet (0.7 to 1.5 meters) above msl and extend to 50 feet (15 meters) above msl along the property line on the southern bluffs. The Del Rey bluffs continue upward to approximately 160 feet (48.8 meters) above msl. Marsh flat elevations range from 0.6 to 1.6 feet (0.2 to 0.5 meters) above msl with channels at 2.2 feet (0.7 meter) below msl. The wetlands in Area B were isolated from the regular tidal influence of Santa Monica Bay when the Ballona Creek levees were constructed in 1932. Currently, a series of flap-gated culverts and self-regulating tide-gates provide for muted tidal influence in Area B. Although tidal channels provide some hydrologic input to a large portion of the wetlands in Area B; the area does not receive normal tidal flushing due to a series of tide gates which connect this area to Ballona Creek. Outflow of water from the site through the tide gates is unrestricted, but inflow from the channel is partially controlled. These tide gates allow local canals to fill and keep the marsh areas adjacent to Ballona Creek generally wetted. Additional sources of inflow in Area B include precipitation and runoff from surrounding areas.

<u>Area C</u>

Area C received substantial fill during the construction of the Pacific Electric Railroad levee (early 1900s), the dredging of the Marina del Rey (1960s), and more recent highway construction. The largest impact occurred during the dredging for Marina del Rey when hydraulically placed slurry was pumped onto Area C. Marina Ditch is an open channel that runs along a portion of the northwest edge of Area C and then extends diagonally to the southeast across the northern half of Area C. The Marina del Rey dredging process left Area C with a high center sloping down to its perimeter, causing the area to no longer retain water for extended periods of time. Fill materials range from 3.5 to 15 feet (1.1 to 4.6 meters) above msl and consist of sand, silt, and clay with variable amounts of construction-related debris. Bore data indicate that, like Areas A and B, the fill material in Area C is underlain by Holocene alluvium consisting of various layers of sand, silt, and clay.

Current elevations range from 4.6 feet (1.4 meters) above msl in a man-made depression south of Culver Boulevard and east of the on-ramp from east-bound Culver Boulevard to north-bound Lincoln Boulevard, to 25.6 feet (7.8 meters) above msl at several mounds in the southwestern portion of the area. Additional depressions are present in the eastern portion of the site, north of Culver Boulevard, where elevations range from 7.4 to 9.4 feet (2.3 to 2.9 meters) above msl. Elevations of the ditch in the northern portion of the area range from 2.4 to 4.1 feet (0.7 to 1.2 meters) above msl. Aside from these specific areas, the majority of the site sits at elevations ranging from 12 to 20 feet (3.7 to 6.1 meters) above msl.

Direct precipitation, runoff from surrounding areas, and storm drain overflows dominate the hydrology of Area C. Additional flows from Marina Ditch and water backed-up behind tidal flap-gates in Ballona Creek also contribute to the hydrology of the area. However, current hydrologic connectivity between Ballona Creek and Marina Ditch allow for only minimal tidal exchange. Storm drains in the area collect water from off-site properties, and overflows from these storm drains sometimes enter Area C.

2.2.4 Plant Communities and Aquatic Habitats

The Ballona Wetlands contain a wide array of aquatic, wetland, and upland habitats including subtidal and intertidal channels, estuarine marsh, brackish marsh, freshwater wetland, seasonal wetland, riparian scrub and woodland, salt panne, dune, grassland, and scrub habitats. The CDFW mapped 57 specific plant alliances or mapping units within 16 major habitat types for the Reserve (CDFG 2007). Many plant alliances and mapping units are dominated by one or more non-native species. No alliances or associations are considered rare or endangered; however, one alliance (*Leymus triticoides* Alliance) and one association (*Frankenia salina-Distichlis spicata* Association) are considered vulnerable (S3) in California (Sawyer et al. 2009).

Descriptions of the plant communities and other habitat elements in the three main areas of the Reserve are provided in the following sections. Plant communities and habitat types at the BWER are shown in Figure 3. This figure has been adapted from the mapping conducted by the CDFW and is included here for contextual purposes only—it is not intended for any planning purpose or for analysis of project impacts. In addition, this adapted figure shows all areas dominated by non-native plant species as such, and does not distinguish between dominants.

<u>Area A</u>

Elevations were raised in Area A with the disposal of dredged materials from the construction of the Ballona Creek Channel and Marina del Rey. The topography and salinity of Area A are presumably the cause for the current vegetation zonation present within this area. Internal drainage carries salts leached from old marsh soils from marginal areas at elevations of 15 to 18 feet (4.6 to 5.5 meters) above msl to central areas ranging from 9.3 to 11 feet (2.8 to 3.4 meters) above msl (PWA et al. 2006). One large area of non-tidal salt marsh habitat occurs within the central portion of Area A and consists of intermixed mudflat habitat and hydrophytic vegetation, with a broad transition to upland habitat. The central and northern portions of Area A are dominated by pickleweed species (*Salicornia pacifica* [*S. virginica*], *S. europaea*, and *Arthrocnemum subterminale* [*S. subterminalis*]), big saltbush (*Atriplex lentiformis*), slender-leaf iceplant (*Mesembryanthemum nodiflorum*), annual bluegrass (*Poa annua*), and open, unvegetated bare ground and salt scald areas. The southwestern portion of Area A contains dense patches of alkali heath (*Frankenia salina*).

Many areas are heavily disturbed, largely due to the presence of encampments of homeless people throughout this area. Due in part to the high levels of disturbance in these areas, vegetation is dominated primarily by non-native, invasive species such as mustards (*Brassica* spp., *Hirschfeldia incana*) and crown daisy (*Glebionis coronaria* [Chrysanthemum *coronarium*]). Large patches of sea fig (*Carpobrotus* spp.) with stands of mulefat (*Baccharis salicifolia*) and coyote brush (*B. pilularis*) are also present along the western boundary of Area A.

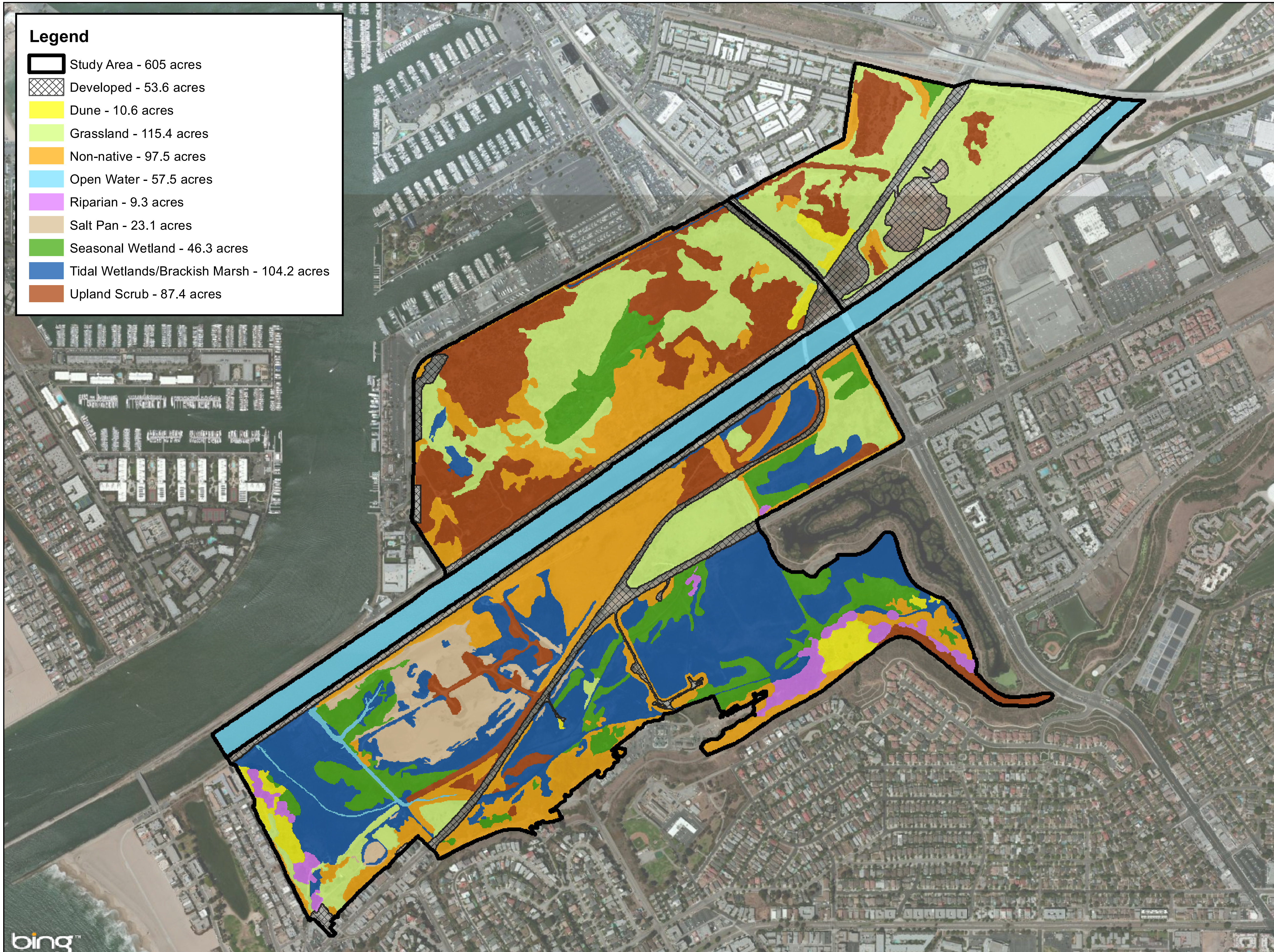
Area B

Area B is the only area within the Reserve that contains unfilled salt marsh habitat. Dominant plant species in moist habitat types in Area B include bristly ox-tongue (*Helminthotheca echioides* [*Picris e.*]), alkali ryegrass (*Leymus triticoides*), annual bluegrass, brass buttons (*Cotula coronopifolia*), toad rush (*Juncus bufonius*), pickleweed species, salt grass (*Distichlis spicata*), broadleaf cattail (*Typha latifolia*), narrow leaf willow (*Salix exigua*), arroyo willow (*S. lasiolepis*), and Italian rye grass (*Festuca perennis* [*F. perenne*, *Lolium multiflorum*, *L. perenne*). In addition, many patches of coast buckwheat (*Eriogonum parviflorum*) occur along the western boundary of Area B. Some parts of Area B are heavily disturbed and harbor a number of non-native species such as eucalyptus (*Eucalyptus* spp.) in the south central area, pampas grass (*Cortaderia selloana*) in the southeast corner, and sea fig along most of the area south of the slough. Stands of willow (*Salix* spp.), coyotebrush, and acacia (*Acacia* spp.) are present along the western boundary near the levee. Area B currently supports the greatest number of native salt marsh plant species of all the areas (Hendrickson 1991).

Area C

Similar to Area A, Area C has been filled with dredge spoils and other material from various sources. The majority of Area C contains large amounts of trash and other debris and a number of encampments of homeless people. These areas are mostly dominated by non-native species such as acacia and mustards. Dominant vegetation within ditches and wetland areas include bristly ox-tongue, curly dock (*Rumex crispus*), Italian ryegrass, large saltbush, slender-leaf iceplant, and alkali heath. In the northeastern corner of the upper portion of Area C, the wetlands contain patches of bare ground as well as areas dominated by hydrophytic vegetation including large saltbush and pickleweed species. The eastern portion of Marina Ditch is dominated by large saltbush. Two areas of remnant dune habitat were identified within Area C by the CDFW (CDFG 2007). These areas are located adjacent to Culver Boulevard, near Jefferson Boulevard. Four developed baseball fields with associated infrastructure are present in the central portion of the southern part of this area and are primarily devoid of vegetation. Lastly, the drainage ditch located along the northeastern side of the baseball fields is dominated by bristly ox-tongue, curly dock, Italian rye grass, and black mustard (*Brassica nigra*).

Despite the degradation of Area C, it still contains some, albeit small, areas inhabited by native species within depressional areas. Newly established populations of native species such as pickleweed and alkali heath have colonized these depressional areas, and speak toward the resilience of such native species.



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Ballona Wetlands Ecological Reserve Conceptual Restoration and Adaptive Management Plan

Marina Del Rey, California

Figure 3.

Biological Communities (Adapted from California Department of Fish and Game 2006)

Map Date: February 2013
Map By: Derek Chan
Base Source: Microsoft Bing Aerial

Path: L:\Acad 2000 Files\00000\00016-3\gis\arcmap\Management Plan\Fig3_BioComms_20130220.mxd

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Ballona Creek

Ballona Creek has been channelized and is currently a lined, trapezoidal creek from its mouth at Santa Monica Bay to the intersection of Venice Boulevard and Pickford Street, approximately 9 miles (14.5 kilometers) upstream. The creek varies in width from 80 to 200 feet (24.4 to 61 meters) and in depth from 19 to 23 feet (5.8 to 7 meters) from the top of the levee. The side slopes are composed of concrete, paving stones, and riprap. The bottom of the creek is only open in the lower, tidally influenced portion, whereas the remaining portions are armored. The vegetation growing along the side slopes consists primarily of ruderal, weedy plant species including bristly ox-tongue, slender-leaf iceplant, and crown daisy. Limited native vegetation including pickleweeds and fleshy jaumea (*Jaumea carnosa*) are present in the western portion of Ballona Creek. Ballona Creek is tidally influenced within the Reserve area.

2.2.5 Floristics

Plant species within the BWER have been well documented throughout the years. Multiple botanical surveys have been conducted within the Reserve for various projects over the past two decades (e.g., Hendrickson 1991; Psomas and Associates 1995; Dorsey and Bergquist 2007; WRA 2011). These studies have included comprehensive floristic inventories and targeted rare plant surveys, as well as transect-based studies aimed at documenting changes in plant communities over time. Johnston et al. (2011) provide a detailed list of the plant species that have been documented at the Reserve. Currently, the BWER contains a mix of upland and wetland habitat types, many of which are dominated by non-native and invasive plant species.

Six special-status plants have been documented from the site: Lewis' evening primrose (*Camissoniopsis lewisii*), Orcutt's pincushion (*Chaenactis glabriuscula* var. *orcuttiana*), South Coast branching phacelia (*Phacelia ramosissima* var. *austrolitoralis*), southern tarplant (*Centromadia parryi* ssp. *australis*), suffrutescent wallflower (*Erysimum suffrutescens*), and woolly seablite (*Suaeda taxifolia*) (WRA 2011). To the extent feasible, occurrences of these species will be preserved during the restoration. If it is not possible to preserve existing occurrences of these species, a mitigation and monitoring plan will be developed to reestablish the impacted species in restored habitat elsewhere in the Reserve. Additional protection and/or mitigation needs may be identified during the CEQA/NEPA analysis and/or during the regulatory permitting process.

2.2.6 Animal Species

Animal occurrences at the BWER have been documented in a number of reports and are summarized in both the existing conditions report (PWA et al. 2006) and the baseline study reports (Johnston et al. 2011, 2012). In general, animal communities at the Reserve are composed of common native and non-native species. However, a number of special-status wildlife species have been documented from the Reserve, although many of these species do not currently occur there. The following sections summarize what is known about the animal communities at the Reserve.

Benthic Invertebrates

Benthic invertebrates provide a reflection of the state of the environment at the transition from water to land and may represent a useful index for the ecological health of an area (Hilty and Merenlender 2000). The presence or absence of certain infaunal taxa within tidal channels can serve as indicators of water quality, anthropogenic stressors to the estuary, and the potential of the estuary to support other trophic levels (Wetlands Recovery Project 2006). Censuses of distribution and abundance have been conducted before and after hydrological modifications within the Reserve to assess the impacts of such projects. Specifically, surveys were conducted before and after the replacement of flapgates (Chambers Group 1996, 1999) and after the installation of the east channel (main) tidegate (City of Los Angeles 2005). Additional benthic surveys of the Reserve include those by Clark (1979), Reish (1980), Ramirez and McLean (1981), Carter (1991), Boland and Zedler (1991), WRA (2004) and Weston Solutions (2005), among others. Benthic invertebrate surveys have primarily focused on Area B; limited surveys have been conducted in Area A, and no surveys have been conducted in Area C.

Benthic invertebrate species observed in one or more surveys are listed in Johnston et al. (2011). Although dominant species were not consistent between reports, the most common species found included: the polychaete worm *Streblospio benedicti* and members of the *Capitella capitata* complex (also polycheates), California hornsnail (*Cerithidea californica*), bent-nosed clam (*Macoma nasuta*), rude barrel-bubble (*Acteocina inculta*), and unidentified oligochaetes. The most commonly represented taxa were annelids, mollusks, and arthropods. Overall, the Reserve has a benthic community dominated by taxa characteristic of southern California coastal wetlands, but with lower species diversity than what might be expect of larger, less disturbed wetlands (Chambers Group 1996). Although no Federal- or State-listed benthic invertebrates have been reported from the Reserve, one species of special concern has been documented. The California brackishwater snail (*Tryonia imitator*) is considered imperiled globally (G2G3) and in California (S2S3) and was reported from Ballona Creek in 1974 (CDFW 2013; NatureServe 2013). The original report was based on the presence of empty shells of this species and there have been no subsequent reports of this species, despite several benthic invertebrate surveys.

Insects

Insects provide a vital link in the food web within a wetland system and are used as indicators for particular species or the overall health of a system (Zedler 2001). The destruction of coastal saltmarsh habitat in southern California has resulted in the decline of the diverse insect communities that rely upon this habitat (Nagano et al. 1981; Mattoni 1991). Invertebrate-based metrics of ecosystem function have centered on taxonomically cataloging the biodiversity of a community (Anderson 2009). In lieu of time-consuming species-level identifications, metrics aimed at describing function or rates may ultimately be better indicators of the current status of a marsh as well as better forecasters of subsequent marsh health (Anderson 2009). These metrics can often be employed rapidly across habitat types, as well as being useful from a management perspective.

The study by Nagano et al. (1981) represents the most comprehensive insect survey of the BWER to date; however, additional surveys include those by Boland and Zedler (1991), Mattoni (1991), Hawks Biological Consulting (1996), and Friends of Ballona Wetlands (2008, 2009, 2010). Insect surveys have primarily focused on Area B, specifically the dune habitats; limited surveys have been conducted in Areas A and C. Insect species observed in one or more surveys are listed in Johnston et al. (2011).

Seven special-status insect species have been observed at the Reserve in recent times: monarch butterfly (*Danaus plexippus*), wandering skipper (*Panoquina errans*), Dorothy's El Segundo dune weevil (*Trigonoscuta dorothea dorothea*), globose dune beetle (*Coelus globosus*), Lange's El Segundo dune weevil (*Onychobaris langei*), Belkin's dune tabanid fly *(Brennania belkini*), and El Segundo blue butterfly (*Euphilotes battoides alluni)*. Special-status insect species observed at the site, or with potential to occur at the site, are discussed in more detail by Johnston et al. (2011) and PWA et al. (2006). To the extent feasible, habitat occupied by these species will be preserved. Most of these species are associated with existing dune habitat at the Reserve and are likely to benefit from on-going restoration efforts in these areas as well as from the potential creation of dune habitat elsewhere in the Reserve.

Fishes

Use of tidal wetlands at the BWER by fish species is arguably one of the most important aspects of the restoration. Defining the fish assemblage of a wetland can be difficult due to the highly mobile nature of the fauna. However, it is this characteristic of mobility that often makes fish some of the first organisms to colonize restored habitats (Zedler 2001). Swift and Franz (1981) were the first to conduct detailed surveys of the fish species within the Ballona area for the "Biota of the Ballona Region" (Schreiber 1981). This was the first study of an upper marsh fish community in southern California and serves as a good historical reference to past conditions and diversity (PWA et al. 2006). Historically, when the Los Angeles River flooded the wetlands, there would have been a higher ichthyofaunal diversity than currently exists at the BWER, including the possibility of several special concern species that have not been seen during surveys in the past 25 years (PWA et al. 2006). A number of additional fish surveys have been conducted in the tidal channels of the Reserve as well as in Ballona Creek and the adjacent Marina del Rey, including those by Allen (1991), Boland and Zedler (1991), Stoltz (1991), the City of Los Angeles (2005, 2009), Merkel and Associates (2009), and Johnston et al. (2011, 2012). Johnston et al. (2011) provide a detailed list of fish species identified in the open water areas of either Marina del Rey or Ballona Creek and within the tidal channels of the Reserve. No special-status fish species have been documented from the Reserve.

Reptiles and Amphibians

Reptiles and amphibians are an integral part of natural ecosystems (Gibbons et al. 2000; Meyers and Pike 2006). Gibbons et al. (2000) reflect that overall declines in reptile and amphibian populations can be attributed in part to many causes, including, but not limited to, anthropogenic factors, habitat loss, invasive and introduced species, pollution, and disease. Past surveys conducted in Areas A and B have yielded a limited reptile and amphibian species diversity; Area C has not been surveyed for reptiles and amphibians. Throughout the years, there have been several species commonly observed on-site including: Great Basin fence lizard (*Sceloporus occidentalis longipes*), western side-blotched lizard (*Uta stansburiana elegans*), San Diego alligator lizard (*Elgaria multicarinata webbii*), California kingsnake (*Lampropeltis getula californiae*), and San Diego gopher snake (*Pituophis catenifer annectens*) (Dorsey and Bergquist 2007; Hayes and Guyer 1981; Hovore 1991; Impact Sciences 1996; Johnston et al. 2009; Society for the Study of Amphibians and Reptiles 2008). Amphibian diversity at the BWER has historically been limited, consisting of Baja California treefrog (*Pseudacris hypochondriaca hypochondriaca*), California toad (*Bufo boreas halophilus*), and garden slender salamander (*Batrachoseps major major*). These species experienced a major reduction in numbers from the early 1980s to the early 1990s, potentially due to drought conditions in 1991 (Hayes and Guyer 1981; Hovore 1991).

Johnston et al. (2011) list the reptiles and amphibians documented from the Reserve in one or more surveys conducted over the past 25 years. Only one special-status reptile or amphibian species has been documented from the Reserve over the last 25 years: California legless lizard (*Anniella pulchra*). This species is associated with existing dune habitat in the western portion of Area B and is likely to benefit from on-going restoration efforts in this area as well as from the potential creation of dune habitat elsewhere in the Reserve.

Birds

The avifauna of the Ballona Wetlands has been particularly well-documented, owing to a recent effort to uncover historical bird records and to describe the area's history of landuse change in relation to the extirpation and colonization bird species (summarized in Cooper 2008). Numerous references to Ballona and the "Venice Marshes" (historic, pre-Marina del Rey wetlands which occurred to the north of the present-day BWER) in early ornithological literature (Grinnell 1898; Willet 1912, 1933; Grinnell and Miller 1944), and comprehensive annotated checklists to the birds of the Ballona Wetlands produced at regular intervals (Dock and Schreiber 1981; Corey 1992; Cooper 2006a) have resulted in a record of bird occurrence dating back over 100 years.

Despite the strong historical record, direct comparisons of today's bird community with that of previous eras is made difficult by the lack of systematic observational data. For example, tables of species occurrence by month or season in the public record are sporadic at best. The vast majority of such data is contained in unpublished notes of observers, which have only recently been explored and synthesized (Cooper 2006a, 2006b). The first known published data tables of sightings reflecting regular surveys by observers over set periods of time are from Dock and Schreiber (1981), who performed weekly walking transects of Areas A and B from February 1979 to June 1981. Corey (1992) conducted bi-monthly surveys of open space both east and west of Lincoln Boulevard from April 1990 to April 1991. Neither of these two studies included Ballona Creek, which is an important waterbird site. Only Corey (1992) appears to have investigated the nesting status of bird species, other than anecdotal observations for a select few species by the other authors. Johnston et al. (2011) provide a detailed list of the bird species documented from the Reserve.

Owing to several decades of litigation regarding proposed development on portions of the open space in and around the BWER, the presence of special-status bird species at the site has been repeatedly and thoroughly documented. That said, the actual number of special-status bird species using a given area is difficult to ascertain. Most species are only afforded special-status if engaged in a particular activity, usually breeding. Only two special-status species were confirmed as actually nesting in the BWER proper: least Bell's vireo (*Vireo bellii pusillus*) and Belding's Savannah sparrow (*Passerculus sandwichensis beldingi*). Four additional special-status species are known to breed nearby and visit the Reserve for foraging including: double-crested cormorant (*Phalacrocorax auritus)*, white-tailed kite (*Elanus leucurus*), Cooper's hawk (*Accipiter cooperii*), and California least tern (*Sterna antillarum browni*); these species do not currently breed at the Reserve and thus are not afforded special protections there. Special-status bird species present at the BWER will be protected according to state and federal requirements, and although some temporary loss of habitat may occur, it is expected that these species will ultimately benefit from restoration activities at the BWER. The population of Belding's Savannah sparrow that currently occupies tidal marsh and salt panne habitats in Area B has been specifically targeted in the restoration planning that has occurred to date, and the extent of restoration activities in Area B (i.e., restoration of the full tidal range in the western portion of Area B) will depend on demonstrated use of restored tidal marsh and salt panne habitats in Area A by this species.

Mammals

The Ballona Wetlands region has suffered a decline in populations of native mammals, a reduction in species ranges, and an increase in introduced species throughout the last century (Friesen et al. 1981). Surveys of the past 29 years throughout the Reserve have yielded a comprehensive mammal diversity of 17 species, three of which are CDFW Species of Special Concern (Friesen et al. 1981; Hovore 1991; Impact Sciences 1996; Erickson 2000; Psomas and Associates 2001; Dorsey and Bergquist 2007; Johnston et al. 2009).

Seven of the species identified in past surveys are considered non-native to the Ballona region: black rat (*Rattus rattus*), domestic cat (*Felis cattus*), domestic dog (*Canis familiaris*), house mouse (*Mus musculus*), Norway rat (*Rattus norvegicus*), red fox (*Vulpes vulpes*), and Virginia opossum (*Didelphis virginiana*). Three of the species identified in past reports are listed as CDFW Species of Special Concern: southern California saltmarsh shrew (*Sorex ornatus salicornicus*), San Diego black-tailed jackrabbit (*Lepus californicus bennetti*), and South Coast marsh vole (*Microtus californicus stephensi*). It is believed that San Diego black-tailed jackrabbit is no longer present at the BWER. In addition, southern California saltmarsh shrew has not been observed at the site since the early 1990s. South Coast marsh vole has been identified from the BWER as recently as 2010 (Johnston et al. 2011), and appropriate measures will be implemented to protect this species during the restoration efforts. Although some temporary loss of habitat may occur, it is expected that this species will ultimately benefit from restoration activities at the BWER.

3.0 RESTORATION DESIGN AND IMPLEMENTATION

The design and implementation elements presented here focus on the biological components of the restoration. The elements presented here are conceptual in nature and are intended to guide a more detailed level of planning which will be necessary as the restoration effort proceeds. The elements presented here build upon the feasibility studies, design alternatives, initial impact assessments developed by ESA PWA, the PMT, and other stakeholders. Input from regulatory agencies, interested organizations, and the general public has also been incorporated into the development of this Conceptual Plan. The final design and implementation of the proposed restoration at the BWER will be informed by the biological components presented here as well as the hydrological and geomorphological design components developed by ESA PWA (2011a-d, 2012a-c) and will be refined through the associated CEQA/NEPA analysis. Although the final shape of the restoration may change, an overview of the restoration (as planned at the time this document was written) is provided in the following sections for contextual purposes.

3.1 Restoration Alternatives

Five restoration alternatives were originally proposed and evaluated (PWA et al. 2008). Of the five restoration alternatives, a single restoration alternative was chosen as the proposed project based on direction from the CDFW (PWA 2010; ESA PWA 2012a); this alternative is referred to here as the "proposed restoration alternative". The proposed restoration alternative includes a realigned, meandering Ballona Creek with shallow subtidal and mudflat habitats gently sloping through a series of estuarine wetland, transition, and upland habitats (Figure 4). Benefits of the proposed restoration alternative include:

- Increased wetland habitat with restored tidal flows
- Broad wetland-upland transition zones
- Protection of upland habitats supporting special-status plant species
- Compatibility with existing and planned infrastructure
- Maintenance of existing levels of flood protection

Although a proposed restoration alternative has been identified, the locations and proportions of the various habitat types may change during subsequent planning phases and in response to the CEQA/NEPA analysis and regulatory permitting process. Therefore, the information presented in this section is conceptual in nature and intended to be applicable to any of the restoration alternatives or variations thereof.

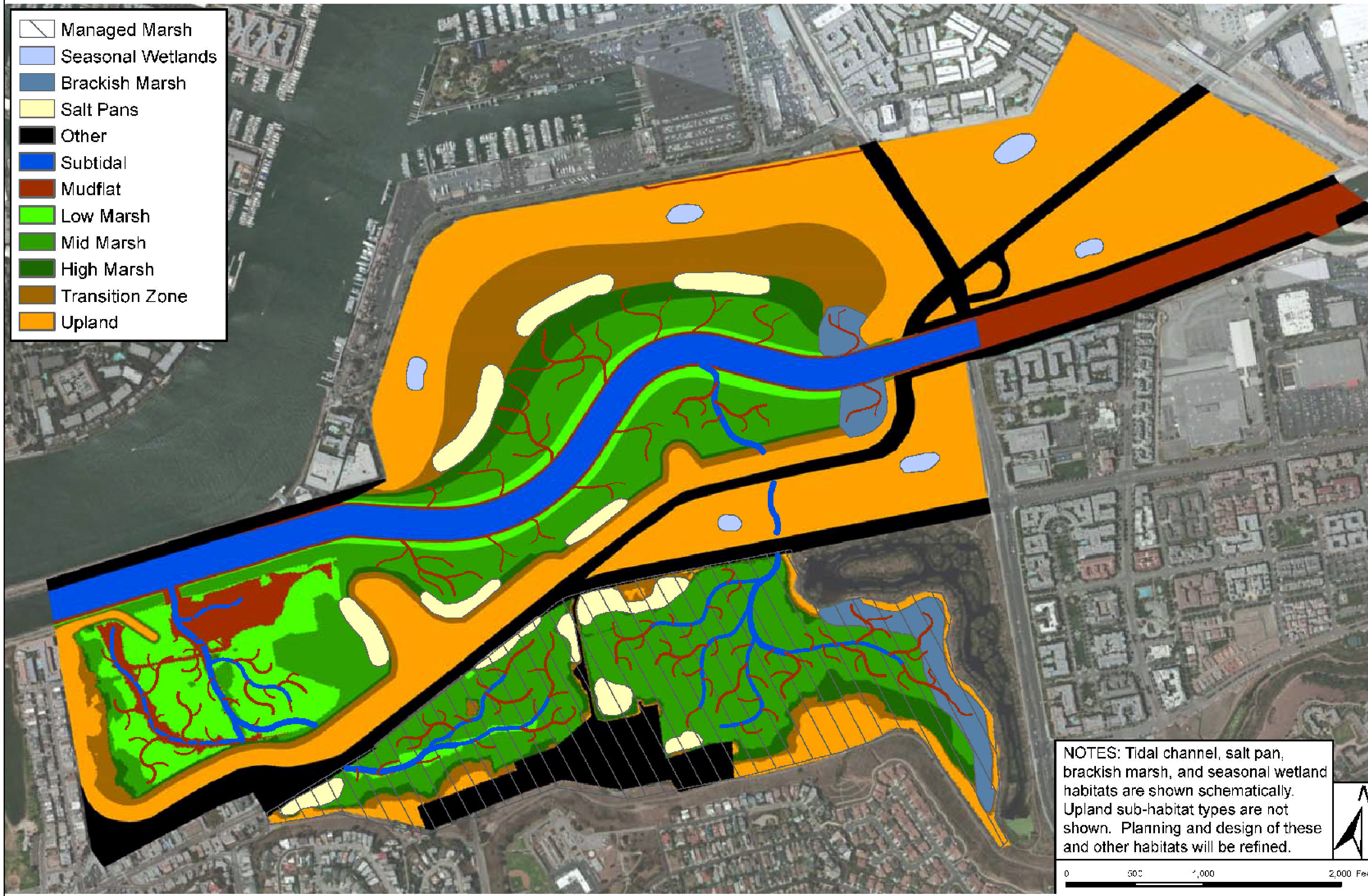
3.2 Target Habitat Composition and Expected Development

The composition of habitats targeted for the restoration at the BWER are primarily based on historical accounts of the habitat previously present at the BWER (Ambrose and Bear 2012; Dark et al. 2011; Mattoni and Longcore 1997; Schreiber 1981) and habitat characterizations provided by Ferren et al. (2008) and Barbour et al. (2007). Given the constraints imposed by the surrounding development, the highly modified nature of the watershed supporting Ballona Creek, existing conditions within the BWER, and projected impacts related to global climate change, re-creation of historical conditions is not possible. Within these constraints, the proposed extent and distribution of habitats in the restored BWER is based on the ecological and biological goals of the restoration (Section 1.2), specifically those related to increasing the total area of tidal wetland habitat and providing high-value habitat for special-status plant and wildlife species.

Physical and biological characteristics of restored habitats within the BWER are expected to develop and evolve over time and will not remain static, particularly given changes expected as a result of global climate change. Restoration will require reliance on natural ecological processes such as sedimentation and erosion and plant succession. Adaptive management will require an understanding of the expected trajectory of habitat development and the underlying ecological processes involved. The following sections provide an overview of the habitats to be restored at the BWER, including the main ecological drivers of habitat development and a description of the vegetation communities and wildlife populations expected to become established in each habitat.

3.2.1 Tidal Wetland (Tidal Channel, Mudflat, Tidal Marsh)

Tidal action is the primary ecological process responsible for developing and maintaining tidal mudflat and wetland habitats (Kolka and Thompson 2006; Sharitz and Pennings 2006). Wave and tidal action redistribute sediment and determine the topography of mudflats, marsh, and tidal channels and how they evolve over time. Tidal inundation, sediment composition, and topography interact to provide the physical conditions that affect the distribution of plant and animal species within a marsh (Mendelssohn and Batzer 2006; Sharitz and Pennings 2006). Tidal marsh plant species vary in their response to the duration and depth of tidal inundation such that each occurs in a unique range of tidal elevations (Zedler et al. 1999). The overlapping distribution of these species is typically simplified and reduced to three marsh vegetation zones in southern California: low, mid-, and high marsh habitats.



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Ballona Wetlands Ecological Reserve Conceptual Restoration and Adaptive Management Plan

Marina Del Rey, California

Figure 4.

Overview of the Proposed Restoration Alternative (Adapted from ICFI 2012)

Map Date: February 2013
Map By:
Source: ESA PWA, ICFI

Path: L:\Acad 2000 Files\00000\00016-3\gis\arcmap\Management Plan\Fig4_PreferredRestoration_20120221.mxd

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Under sediment-limited conditions, tidal marshes typically form by a slow, interactive process of sediment accretion and plant colonization (Kolka and Thompson 2006; Sharitz and Pennings 2006). However, at sites with high sediment loads, the process of tidal marsh development may occur more rapidly (Wallace et al. 2005). As a result of development within the Ballona Creek watershed, sediment loads in Ballona Creek are relatively low, and sediment accretion within restored wetlands at the BWER is expected to be slow. This will necessitate grading of restored tidal marsh and larger channel habitats to near target elevations. Smaller tidal channels are expected to develop over time, and it is expected that all tidal channels will migrate to some degree over the life of the restoration.

Tidal marsh plants can be sensitive to elevated salinity, acidic soil conditions, elevated concentrations of certain naturally occurring elements, and extremes in soil texture. To provide a suitable substrate for marsh vegetation, specifications for marsh soils will be developed and testing of on-site soils will conducted to determine whether there is potential to reuse excavated soils from Areas A and C. Salvage of historic marsh soils buried under dredge spoils placed north of Ballona Creek during creation of the Marina Del Ray harbor may provide a source of suitable marsh soil to use on the marsh surface, although some modification of the soil may be necessary to restore the physical and chemical properties necessary for plant growth.

Because sedimentation rates from the Ballona Creek watershed and from Santa Monica Bay are expected to be low, loss of sediments to the Bay is a potential concern, especially with rising sea levels. Rapid vegetative colonization of low, mid-, and high marsh habitat will be important in reducing the loss of sediments. Planting or seeding of the marsh surface may help speed the colonization process and limit sediment loss. Although a vegetated marsh surface is desirable in terms of reducing sediment loss, some portion of unvegetated mudflat habitat is desired as this provides prime foraging habitat for many wading and shorebirds and provides valuable habitat for benthic invertebrates.

Re-vegetation will rely on natural establishment as much as possible. Some salt marsh species will colonize areas of sediment accretion where dispersing seeds can become buried in sediment until spring germination. However, plant establishment may be limited where seed is unavailable, sediment erosion is active, or salinity is exceptionally high. Studies conducted as part of the restoration of Tijuana Estuary determined that establishment of most common tidal marsh plant species is improved when the species are planted or seeded; pickleweed was the only tidal marsh species that colonized well on its own (Lindig-Cisneros and Zedler 2002). Some level of active planting or seeding will be necessary throughout the tidal marsh habitat, but will be especially important in the high marsh zone to provide competition with weeds and to reach the high levels of plant diversity generally found in this portion of tidal marshes. Establishment of species such as alkali heath, saltgrass, and other target species in the high marsh and transition zones will require use of container plantings and irrigation. Establishment of pickleweed in the mid marsh may occur naturally given the proximity of propagules in portions of the BWER and surrounding areas. However, planting stands of other mid-marsh target species will be necessary to encourage species heterogeneity in the mid-marsh. Additional planting may be necessary in locations with high erosion potential such as adjacent to inlets and along tidal channels. Pacific cordgrass (*Spartina foliosa*) is often the dominant plant in the low marsh zone of tidal wetlands in southern California (Zedler et al. 1999) and could recolonize naturally given a nearby seed source. However, Pacific cordgrass does not currently occur at the BWER or in the immediate vicinity, and transplanting from nearby marshes would be necessary to create cordgrass stands at the BWER. Other low marsh species such as salt marsh bird's beak (*Chloropyron maritimum* [*Cordylanthus maritimus*]) should also be considered for establishment at the BWER. The federally endangered subspecies of this plant was successfully established in restored habitat at San Diego Bay where suitable host plants and pollinators were present (Parsons and Zedler 1997).

A significant effort to control invasive plant species will be necessary to ensure establishment of native species in the high marsh and transition zones. Regular tidal inundation and elevated salinity levels in the low and mid-marsh zones will help prevent colonization by non-native ruderal species. However, the decreased frequency of tidal inundation in the high marsh and transition zones makes these areas more susceptible to invasion by non-native ruderal species, particularly after rainfall events which may lower soil salinity (Noe and Zedler 2001a, b). This increased susceptibility to invasion will require greater focus of management activities in these areas to maintain the desired native vegetation.

Target habitat acreages for tidal wetlands will be developed in later stages of the restoration with input from the project design team, guidance from the CEQA/NEPA analysis, and regulatory requirements. The primary targeted species for tidal wetland restoration at the BWER include Pacific cordgrass in the low to mid-marsh zones, pickleweed in the mid-marsh to high-marsh zones, and a combination of Parish's glasswort (*Arthrocnemum subterminale*), shoregrass (*Monanthochloe littoralis*), saltgrass, alkali heath, and coastal gumweed (*Grindelia stricta*) in the high marsh zone (see the potential plant palette provided as Appendix A). Additional species will be considered for establishment in each of the marsh zones to increase native plant diversity within the tidal marsh.

The conflicting dynamics of sedimentation and sediment removal and associated shifts in vegetation should be anticipated in the monitoring and management phases of the restoration. Target acreages for specific wetland habitat and vegetation zones should be flexible, and performance goals should emphasize hydrogeomorphic functionality, vegetative cover, and use by tidal wetland-associated wildlife species.

3.2.2 Brackish Marsh

The Freshwater Marsh will be retained and operated as it is at present. However, a portion of the outflow from the Freshwater Marsh may be redirected to connect with the channel system in the restored managed tidal wetlands south of Jefferson Boulevard and east of the Gas Company road, creating a brackish marsh transition zone between the Freshwater Marsh and the restored tidal wetlands.

Brackish wetlands are formed in portions of tidal marsh receiving seasonal or perennial input of freshwater (Desmond et al. 2001). In southern California, these areas are generally dominated by California bulrush (*Schoenoplectus californicus*), southern cattail (*Typha domingensis*), ditch grass (*Ruppia maritima*), and spiny rush (*Juncus acutus*) (Desmond et al. 2001). At the BWER, the Freshwater Marsh receives runoff from the adjacent development and the Jefferson Boulevard storm drain, and outflow from the Freshwater Marsh is directed into Ballona Creek via a gated culvert. After the proposed restoration, a portion of the outflow from the Freshwater Marsh will be directed to the restored tidal marsh in the eastern portion of Area B. An area of brackish marsh will develop where outflow from the Freshwater Marsh meets inflow from the restored tidal marsh. The degree and extent of brackish conditions will depend on the amount of freshwater entering the restored tidal marsh at any given time. The flow of water from the Freshwater Marsh will be controlled via the existing overflow weir or via gated culverts installed in the marsh levee. In addition, current project plans call for the installation of a tide gate at the inlet to this portion of Area B, thereby providing a means to regulate the flow of saline tidal water into the brackish marsh area. The ability to control the flow of both freshwater entering from the Freshwater Marsh and saline water entering from the tidal marsh provides the means to regulate the degree and extent of brackish conditions and to manage this area to promote species diversity and high-quality habitat for brackish marsh-associated species such as tidewater goby (*Eucyclogobius newberryi*), Pacific staghorn sculpin (*Leptocottus armatus*), longjaw mudsucker (*Gillichthys mirabilis*), or topsmelt (*Atherinops affinis*). However, even with the ability to control the flow of water into the marsh—and thereby control salinity levels and other aspects of water chemistry—it will be difficult to predict the extent to which brackish conditions will develop, and it is likely that such conditions will vary from season to season and from year to year.

The brackish marsh, particularly the upper portions of the marsh which will receive less frequent inundation, will be vulnerable to invasion by non-native weed species. As conditions become less saline and tidal inundation becomes less frequent, a greater suite of invasive species will be able to become established. Maintaining more saline conditions by limiting the amount of freshwater entering the brackish marsh may be one way to minimize the potential for invasion of non-native weeds. The use of densely spaced restoration plantings that will fill in quickly and limit the availability of light and nutrients may also help to reduce potential for invasion.

Due to the variable nature of brackish marshes—including large intra- and inter-annual variations in salinity levels (Desmond et al. 2001)—it is difficult to describe a target area or vegetation community for this habitat. Vegetation should include some combination of California bulrush, southern cattail, ditch grass, spiny rush, pickle weed, saltgrass, alkali heath, and other species typical of habitats ranging from freshwater to tidal wetlands (see the potential plant palette provided as Appendix A). Target acreages for brackish marsh should be flexible as it is likely that the extent of brackish conditions will shift from season to season and year to year. Performance goals should focus on both the composition of the vegetation and the total area of vegetative cover. Plantings will be required in this area and should focus on dominant species characteristic of brackish marshes. It may be desirable to also plant small patches of non-dominate species to increase native plant diversity in the brackish marsh.

3.2.3 Salt Panne

Salt pannes develop in shallow depressions along the upper edges of the high marsh zone. They occur at elevations high enough to receive only occasional high tides. Salt panne depths are shallow enough that they do not collect excessive amounts of rainfall and can dry down between tide events. Salt pannes are often ponded for long periods during the winter and spring months and dry for longer periods during the summer. The input of saline water combined with successive periods of flooding and evaporation creates hypersaline conditions that exclude most plants (Pratolongo et al. 2009). With changes in the duration and frequency of ponding and changes in salinity levels, salt pannes have the potential to grade into either seasonal wetland or tidal marsh habitats. Two hydrologically distinct forms of salt panne habitat currently occur at the BWER: (1) those that receive water input primarily from spring and other high tides, depending on the levels at which the tide gates are set and (2) those that receive water input from seasonally shallow saline groundwater and stormwater runoff. In both cases, extended periods of evaporation result in concentration of salts in the upper portion of the soil, resulting in a lack of vegetation over large portions of these habitats. Created salt panne habitat at the BWER will be primarily of the first type, receiving water input primarily from spring and other extreme tides. However, given the presence of saline soils and the likelihood of saline groundwater occurring in many portions of the Reserve, some of areas designed as seasonal wetland habitat may develop high concentrations of salts at the soil surface, thus resulting in the formation of salt panne-like conditions.

It is unclear how long it may take for salinity to reach levels sufficient to exclude most plants, and creation of salt panne habitat at the BWER will benefit from incorporation of high-salinity soils salvaged from existing salt panne habitat that will be lost to tidal wetland restoration or from high-salinity soils excavated from deeper within the soil profile. In addition, it may be desirable to add salt to the pannes to increase salinity levels more rapidly. Given the uncertainty regarding salt panne development and function, a phased approach will be used wherein salt panne design will be tested in Area A, and the results will be carefully evaluated prior to implementation in the other portions of the Reserve.

Target habitat acreages for seasonal wetlands will be developed in later stages of the restoration with input from the project design team, guidance from the CEQA/NEPA analysis, and regulatory requirements. At peak salinity levels, salt panne habitat should exclude the germination and establishment of most plants; however, it is likely that initial post-construction salinity levels may not be high enough to exclude all plants. Moreover, typical tidal marsh plant species such as Parish’s glasswort, pickleweed, and saltgrass may become established in a developing salt panne when surface salinities are not yet elevated and then persist as the salt panne develops higher salinity by tapping into lower-salinity water deeper in the soil profile, thereby resisting exclusion by high surface salinities. Weeds with some salt tolerance such as perennial pepperweed (*Lepidium latifolium*) may also become established during the initial years of the restoration when salinity levels are relatively low, and more intensive weed management may be necessary during this time period. As salinity levels rise with each successive dry-down period, plants should be naturally excluded from germinating and establishing within the salt panne habitat and less weed management will be necessary. Although new plants are likely to be prevented from establishing once salinity levels are sufficiently high, it may be necessary to remove plants which became established when salinity levels were low.

3.2.4 Seasonal Wetland

Seasonal wetlands generally develop in low-lying areas that collect rainfall and other runoff or receive input from seasonally elevated shallow groundwater. These habitats are dependent on ponded conditions that persist for a limited period following the rainy season and which promote the development of hydric soils and hydrophytic vegetation. The duration and depth of ponding is the major determinant of plant community development in seasonal wetlands (Kolka and Thompson 2006). Longer periods and deeper depths of ponding will result in vegetation dominated by wetland-adapted, sometimes perennial species whereas shorter periods and more shallow depths of ponding may result in vegetation dominated by annual species adapted to fluctuating moisture regimes. At the BWER, soil salinity will also play a major role in determining the plant communities that will develop in seasonal wetlands.

Target habitat acreages for seasonal wetlands will be developed in later stages of the restoration with input from the project design team, guidance from the CEQA/NEPA analysis, and regulatory requirements. Seasonal wetlands will be designed to have a range of inundation depths and durations and will be strategically located throughout the upland and transition habitats throughout the Reserve. The location of these wetlands will be designed to allow for a transition from vernal pool to salt panne habitat in conjunction with expected rates of sea level rise. As sea levels rise, salt panne habitat within the transition zones should undergo natural conversion to tidal marsh habitat and seasonal wetlands located higher in the transition zones and upland habitats will likely undergo conversion to salt panne habitat. This should result in an overall loss of seasonal wetland habitat, but should allow for natural establishment of new tidal marsh and salt panne habitat as sea levels rise.

Historically, seasonal wetlands on coastal terraces in the Ballona region supported a high diversity of freshwater vernal pool plant species (Mattoni and Longcore 1997). The focus of seasonal wetland restoration in areas of low-salinity soils at the Reserve will be on the creation of shallow depressions with appropriate soils for supporting a similar assemblage of southern California vernal pool plant species (see Appendix A). Vernal pools and other seasonal wetlands are formed in two ways: (1) by fine textured low-permeability subsoils which perch shallow groundwater or (2) by seasonal exposure of high water tables through more coarse-grained soils (Zedler 1987; Mitsch and Gosselink 2000; Kolka and Thompson 2006). Investigation of the relationship of topography and soil permeability to surface and subsurface hydrology and salinity at the BWER is necessary to inform the appropriate design of the seasonal wetlands to be created. Analyses will be conducted in existing seasonal wetlands to determine how they function and will also be conducted in the sites proposed for creation of seasonal wetlands to determine what type of seasonal wetlands these areas can support. If the sites selected for seasonal wetland creation contain high water tables, the created seasonal wetlands will be excavated to an appropriate depth to reach this high water table. If the sites selected for seasonal wetland creation do not contain high water tables, the created seasonal wetlands will be designed with a compacted layer of fine-textured soil which will perch shallow groundwater. Additional topographic and hydrological analyses will be necessary to ensure that seasonal wetlands of this design are fed by an appropriately sized watershed.

3.2.5 Riparian Scrub and Woodland

Riparian habitats are shrub- or tree-dominated areas which develop along the edges of ephemeral, intermittent, or permanent streams or rivers (National Research Council

2002; Mitsch and Gosselink 2000). Habitats within the Reserve which have been classified as *riparian* in the existing conditions report prepared by PWA et al. (2006) may be better described as palustrine scrub or shrub wetlands or palustrine forested wetlands (CDFG 2007) as these features occur not along streams or rivers, but rather adjacent to wetlands or within seasonally ponded areas or areas with shallow water tables. Hydrology is the primary ecological driver for these plant communities, and as such, riparian plant communities within the Reserve are vulnerable to changes in hydrology resulting from grading activities associated with the restoration. In addition, many of the species within these communities may be sensitive to salt, and the restoration of tidal marsh habitat adjacent to these habitats may increase exposure to saline groundwater.

Some portion of the mapped riparian scrub vegetation within the southern and eastern portions of Area B will be lost to the restored tidal and brackish marsh habitats. However, the eucalyptus grove located in Area B, near the terminus of Falmouth Avenue, will be preserved as these trees are currently used as roosting habitat for monarch butterfly. The trees will be monitored and managed as needed to maintain suitable habitat conditions for the monarch population and will eventually be replaced with native trees suitable for the site and for monarch roosting. Replacement of the eucalyptus trees will occur in phases according to a replacement plan which will be developed in conjunction with the CDFW. During the interim period, the eucalyptus grove will be prevented from increasing in size or extent. Riparian habitat within Area C is may be lost to upland habitat restoration and construction of the interpretive visitor center and associated facilities planned for this area. The final acreage of riparian habitat to be either preserved and enhanced or created will be determined in later stages of the restoration with input from the project design team, guidance from the CEQA/NEPA analysis, and regulatory requirements. Riparian vegetation not removed during the restoration may be vulnerable to dieback resulting from changes in hydrology or salinity resulting from the creation of tidal wetland habitat immediately adjacent to these areas. Any grading to occur in or around preserved riparian habitat will need to be undertaken with consideration of the available sources of water for these habitats and should strive to maintain existing levels of water input to prevent large-scale dieback in these areas. Management of riparian areas will focus on the removal of invasive plant species (exclusive of the eucalyptus grove in Area B) and incorporation of appropriate native riparian plants (see Appendix A) to increase diversity and provide appropriate habitat structure for riparian wildlife species.

3.2.6 Dune

Coastal dunes in their natural condition are inherently dynamic systems changing in response to wind and waves (Nordstrom 2008). Plant species typically associated with dune habitat have evolved a variety of reproductive and competitive strategies to adapt to the constant disturbance of accreting and eroding sand (Pickart and Barbour 2007). Dunes within the Reserve are remnants of a once larger dune system and are relatively isolated from the sand source and prevailing winds that are the ecological drivers which would normally shape these systems. Restoring the dunes to a more natural, self-sustaining condition is not possible given the development that has occurred west of the dunes; however, ongoing planting and invasive species control efforts led by Friends of Ballona Wetlands have restored portions of the dunes with native plant species typically found in southern California dune systems. Within these plant communities are several special-status plants (e.g., South Coast branching phacelia) as well as potential host plants for special-status invertebrates (e.g., El Segundo blue butterfly).

The existing dunes occurring in the western and southeastern portions of Area B will remain under the proposed restoration. Management activities will focus on limiting anthropogenic disturbances, removing non-native species, and encouraging the establishment of both common and rare native dune species. A limited area of dune creation may be undertaken in several additional portions of the Reserve. Similar to existing dune habitat, the created dunes will not be subject to the ecological drivers which would naturally shape these systems. The goal of dune creation should be to provide suitable sand substrate and habitat structure to encourage the development of dune vegetation similar in structure and composition to the vegetation of the existing dunes. Dunes creation should make use of clean sand of similar grain-size to that of the existing dunes. Sand can be sourced from off-shore dredging or from inland quarries. Dredged sand is more likely to be of compatible grain-size and parent material; however, it is also likely to be too saline for most dune plants and will require extensive leaching or capping with 1 to 2 feet (0.3 to 0.6 meter) of inland sourced sand. Inland sourced sand is more likely to be of less compatible grain-size and parent material; however, salinity should not be an issue. The physical structure of created dune habitat should mimic that of existing dunes at the Reserve.

Target vegetation for existing and created dune habitat will be similar in diversity and structure to stabilized back-dune systems in the region, with high diversity and cover of native species, including both woody perennials and herbaceous annuals. During the initial phases of the restoration when plant cover is low, erosion control measures such as the use of sand fencing, hay bales, crimped straw, or jute netting may be necessary to stabilize the sand (Nordstrom 2008). In addition, plantings may benefit from limited application of slow-release fertilizer and supplemental irrigation. It is important that only slow-release fertilizer be used for these applications, as slow-release fertilizer reduces the potential for eutrophication of adjacent waters. In addition, the slow-release fertilizer should be incorporated into the planting holes, rather than being broadcast over large areas—this will ensure that the fertilizer is used by the installed plants rather than by weeds growing between the plantings.

3.2.7 Upland Scrub and Grassland

The primary goal of upland habitat restoration at the BWER is to provide support functions for the larger tidal wetland restoration including reducing sediment loads to seasonal and tidal wetlands and providing high tide refuge for tidal wetland wildlife. Target habitat acreages for upland scrub and grassland habitats will be developed in later stages of the restoration with input from the project design team, guidance from the CEQA/NEPA analysis, and regulatory requirements. Upland habitats (exclusive of the dunes) should have high plant cover and a diverse composition of native shrubs and herbaceous plants. The composition of this vegetation may be limited by potentially high salinity levels in soils throughout the Reserve. Target vegetation includes grasslands dominated by species such as California barley (*Hordeum brachyantherum* ssp. *californicum*), purple needlegrass (*Nassella pulchra*), saltgrass, and alkali ryegrass (*Elymus triticoides*) and scrub dominated by species such as coyote brush, California sagebrush (*Artemisia californica*), mugwort (*Artemisia douglasiana*), big saltbush, lemonade berry (*Rhus integrifolia*), and seacliff buckwheat (*Eriogonum parvifolium*). Additional species will be included in both upland habitat types to increase overall native plant diversity. It should be expected that non-native annual grasses will also form a major component of both grassland and scrub habitats given their prevalence in the seed bank.

If soils used for the creation of upland habitat are highly saline, a 3- to 4-foot cap of clean, non-saline soil may be required to allow for establishment of salt-intolerant species. Even with a cap of non-saline soil, there is potential for saline groundwater to move up through the soil profile and for saline conditions to develop in the root zone. In the event that this becomes an issue at the BWER, a more limited palette of highly salt-tolerant upland plants will be required (see the potential plant palette provided as Appendix A). Given that upland habitat at the BWER will be limited in extent relative to tidal wetland areas, it may be possible for temporary irrigation to be used during the establishment of upland plantings—this would increase the success rate of upland plant establishment, particularly for native bunchgrasses and woody perennials.

3.3 Overarching Elements of the Restoration

The following sections outline the approach to the overarching elements of the proposed restoration, those elements which are common to most or all habitats, including hydrology, soils, vegetation, and public access. This overview is intended to provide context for the subsequent sections of the Conceptual Plan and to provide guidance for the restoration design where appropriate. Details of the proposed restoration are provided by PWA (2010) and ESA PWA (2012a) and are subject to modification based on input from the project design team, regulatory requirements, and results of the CEQA/NEPA analysis. The restoration will be conducted in phases, with the structure of the latter phases being informed by lessons learned during the first phases, and thus the approach presented here may also be subject to change based on outcomes of the first phases of the restoration.

3.3.1 Hydrology

The proposed restoration includes the realignment of Ballona Creek and the restoration of full tidal activity into Areas A and B. Ballona Creek will be realigned along the length of Area A to include achieve a more natural, sinuous path with meanders bringing the channel into both Area A and Area B. Restoration of tidal activity will include the installation of culverts and self-regulating tide gates as well as the creation of tidal channel networks in the restored wetlands. Self-regulating tide gates will allow the full range of tidal activity while maintaining required levels of flood control. Tide gates may be closed during extreme tides or during storm events in Ballona Creek. Restoration of tidal activity will bring saline water into restored tidal wetlands which will become the driving force behind ecological processes in these areas.

3.3.2 Soils

A large volume of soil was placed in Area A during the construction of Marina del Rey. The majority of this soil will be excavated to restore appropriate tidal elevations throughout the BWER. Excavated soil will be re-used on-site to the greatest extent possible. Excavated soil will be used to create upland peninsulas in the restored wetlands in Areas A and B and to restore uplands in Area C. Excavated soil will also be used to construct flood control levees in Areas A and B.

Appendix B provides a summary of the initial soil analyses conducted at the site as they relate to the establishment of plant communities. Based on these initial analyses, it has been determined that soil salinity may be an issue in the excavated soils, with surface soils containing lower levels of salts and subsurface soils containing salts at levels too high for even the most salt-tolerant plant species. In addition, levels of several essential plant nutrients may be too low to support desired levels of plant growth. Specifically, nitrogen, phosphorus, calcium, and zinc were found to be lower than preferred for the establishment of healthy native plant communities. Given the low levels of these plant nutrients in soils at the site, limited application of fertilizer may be needed. Analyses of sodium absorption ratios show an imbalance between sodium and soluble calcium and magnesium, which can negatively affect soil structure and water infiltration in soils used outside of a salt marsh setting (e.g., soils used for upland restoration). Incorporation of gypsum combined with extensive leaching may be necessary to reduce sodium levels and improve sodium absorption ratios. Soil texture was shown to range between sand and loam, with most samples being relatively sandy. The more coarsely textured soils (i.e., sandy soils) will have reduced water holding capacity and may not be suitable for establishing plant communities adapted to mesic conditions. The use of soil amendments to increase the water holding capacity of on-site soil or the use of imported soil may be necessary if sufficient amounts of finely textured soils cannot be sourced on-site.

Due to the extensive volume of soil involved in the restoration, the use of soil amendments to alter soil texture or chemistry may be cost-prohibitive. Similarly, importing soil at the scale required for the restoration may also be cost-prohibitive. Given the expense involved in importing soils to the site, including the potential need to export "unusable" soil from the site, every effort will be made to reuse soil on-site. This will require an extensive analysis of soil texture and chemistry throughout both the areas to be excavated and areas of existing salt-adapted and salt-sensitive vegetation—this will provide a detailed understanding of the range of physical and chemical soil conditions across the site, as well as the range of salinities tolerated by existing plant communities at the site. Analyses will be designed to identify the vertical and horizontal distribution of important physical and chemical soil properties; these data will be used to inform the salvage and re-use of excavated soils during the restoration.

Finer textured soils with high organic content will be incorporated into the top 1 to 2 feet (0.3 to 0.6 meter) of mudflat and tidal wetland habitat up to the mean high water line, above which more coarsely textured soils may be incorporated. Highly saline subsoils, as well as highly saline surface soils, will be used for the construction of salt panne habitat. To the extent feasible, highly saline soils will not be used to create upland habitat. However, it is likely that an insufficient amount of non-saline soil will be available on-site for the creation of upland habitat and it will be necessary to use some amount of saline soil for this purpose. Where saline soils are used to create upland habitat, they may need to be amended with gypsum and extensively leached with freshwater and/or covered with a 3- to 4-foot cap of non-saline soil salvaged from elsewhere at the site or imported from off-site. Although there is potential for salts to be wicked up through the soil profile over time, a thick cap of non-saline soil will allow plants to become established and to acclimate to slowly increasing salinity levels. If the use of soil amendments and/or importation of non-saline soil is cost prohibitive, a salt-tolerant plant palette will be required. Appendix A identifies native salt-tolerant plants suitable for including in the restoration design.

3.3.3 Vegetation

Establishment of vegetation in the restored habitats will be based on a combination of natural revegetation and planting or seeding with native plant species appropriate to the hydrologic, soil, and climatic conditions at BWER. Due to the extensive area involved in the restoration and the potential cost involved in the use of potted plants and plugs, natural revegetation and/or seeding will be used whenever possible. Areas receiving regular tidal inundation are ideal for natural revegetation as tidal waters can contain large numbers of propagules for plants suited to tidally influenced habitats—these include low and mid-marsh habitats as well as brackish marsh habitats. Limited installation of potted plant material or plugs may be used in these areas to speed recolonization of the marsh plain, especially in Area A where input of dispersing seed will likely be low due to the low cover of tidal wetland plants currently present in this portion of the BWER. Subsoils and soils excavated from existing marsh or salt panne habitat may lack a suitable seedbank for natural revegetation in uplands; however, if this is the case, these soils will have the advantage of lacking an upland weed seedbank as well. These areas will require seeding with an appropriate mix of native herbaceous plants with supplemental planting of native shrubs. Alternatively, shrubs may be seeded; however, establishment of shrubs from seed is a slow process and better results are likely to be achieved through the use of potted plants. Given the need for sand stabilization in the created dunes, the use of potted plants and plugs is preferred over natural revegetation in this habitat.

Plantings will require careful phasing to ensure that plants are installed at the correct time of year (ideally at the onset of winter rains) and that plantings occur as soon as possible after final grading. This will help ensure successful establishment with minimal need for irrigation, reduce the potential for erosion, and minimize colonization by weedy non-native species. Plantings in high marsh, transition, and upland habitats (including dunes) are likely to require supplemental irrigation during the first two to three years after planting. Supplemental irrigation greatly improves the success of restoration plantings, and the added cost of installing temporary irrigation should be viewed as an investment in the long-term success of the restoration.

A potential plant palette is provided as Appendix A. This list was developed based on the suite of native species documented in the existing conditions and baseline studies reports (PWA et al. 2006; Johnston et al. 2011, 2012) as well as on historical references and plant lists from other coastal wetlands in southern California (Schreiber 1982; Mattoni and Longcore 1997; Sullivan and Noe 2001; Dark et al. 2011; Sawyer et al. 2009). The species included in the list are all native to southern California. Efforts have been made to limit the species on this list to those historically present in the greater Los Angeles region; however, some species have been included based their ease of propagation and adaptability to a wide range of environmental conditions.

There is potential to salvage some of the existing vegetation for use in restored habitats; however, use of salvaged plant material will require careful timing to ensure plants are removed from existing habitat and replanted during appropriate phenological stages and during appropriate times of year, both of which are species-specific. Salvaging existing vegetation would require an extensive area of land, either on-site or off-site, devoted to propagation and staging. Because the plants being salvaged or propagated would be adapted to the local climate, heated greenhouse facilities may not be necessary; however, other infrastructure would be necessary. Such infrastructure might include shading structures, raised beds, propagation benches, irrigation, fencing, etc. Although the cost of salvaging plant material from the site could be reduced through the use of volunteers, dedicated staff experienced in large-scale plant propagation would be necessary. Alternatively, the stockpiling and maintenance of salvaged plant material can be contracted out to a reputable nursery or a firm specializing in habitat restoration. It is unlikely that all of the plant material needed for the restoration can come from salvaged plant material, and propagation of additional plant material will be necessary. Plant propagation should be accomplished through collection of seeds and cuttings from healthy populations within the Santa Monica Bay watershed. If suitable donor populations cannot be located within this watershed, plant propagules may be sourced from adjacent watersheds; however, efforts should be made to collect plant material from as close to the BWER as possible to maintain the genetic integrity of the regional flora and to ensure that the plants are adapted to the local climate. A large amount of plant material will be required over the lifespan of the restoration and it will be important to have ample material available during the initial planting and for supplementary planting in subsequent years as habitats develop. Initial plantings should focus on the dominant species desired in each habitat, with supplementary plantings to increase diversity in later stages of the restoration.

A detailed planting plan will be developed for the restoration and will outline protocols for plant sourcing and propagation, necessary infrastructure and staffing for on-site salvage and propagation, requirements for contracted plant salvage and propagation, specifications for soil amendments and irrigation, specifications and a schedule for planting and subsequent management actions, and a weed control plan to ensure successful establishment and long-term maintenance of plant communities at the BWER.

3.3.4 Special-Status Species

A number of special-status plant and wildlife species have been identified at the BWER; these species are listed in Sections 2.2.5 and 2.2.6, respectively. Except for Lewis' evening primrose and wooly seablite, special-status plant species at the BWER are restricted to the dune habitat in the western portion of Area B (WRA 2011). Lewis' evening primrose occurs in the dune habitat, but also occurs in large numbers in Area C and in smaller numbers in the southeastern portion of Area B (WRA 2011). Wooly seablite occurs along the southwestern edge of Ballona Creek (WRA 2011). Given that work within the dunes in the western portion of Area B will be largely limited to weed removal and planting of appropriate native species, existing special-status species in this area are unlikely to be negatively impacted by restoration activities. Instead, it is likely that restoration activities in the dunes will benefit the special-status plant species present there. It is unclear at this point how restoration activities will affect the occurrences of Lewis' evening primrose outside of the dunes or the occurrences of wooly seablite along Ballona Creek. Occurrences of these species will be protected to the extent feasible. Focused monitoring efforts will be implemented for occurrences of these species that are to be protected, and appropriate management efforts will be undertaken if populations decline significantly. Any impacts to these species will be mitigated on-site through re-establishment of impacted species in restored habitat at the Reserve—this may require collection of seed or other propagules prior to impacting the species. Re-establishment and subsequent monitoring efforts for impacted species will be implemented according to a mitigation and monitoring plan developed in accordance with appropriate local, state, and federal policies or regulations.

Similarly, most special-status insects and the only special-status reptile (California legless lizard) known from the BWER are restricted to the dune habitat in the western portion of Area B. Given the limited extent of restoration activities in this area, it is unlikely that these species will be negatively impacted by the restoration. Instead, it is likely that these species will benefit from the on-going restoration activities in this habitat. Focused monitoring efforts will be implemented to ensure that populations of these species either remain at pre-restoration levels or increase in size, and appropriate management efforts will be implemented, as feasible, if populations of these species decline in size.

Although the South Coast marsh vole may experience some temporary loss of habitat during the restoration, it is expected that this species will ultimately benefit from tidal marsh and upland grassland restoration efforts at the BWER. This species will be protected during restoration efforts following protocols approved by the CDFW. Following the completion of restoration efforts, focused monitoring efforts will be implemented for this species to ensure that its population remains at pre-restoration levels or increases in size, and appropriate management efforts will be implemented, as feasible, if the population of this species declines in size.

Given the major grading and other activities planned in areas occupied by Belding's Savannah sparrow or least Bell's vireo, the restoration has potential to negatively impact these species during project construction. To reduce the potential for negative impacts, appropriate avoidance and minimization measures will be implemented following standard protocols approved by the CDFW. In addition, habitat actively occupied by either of these species will not be impacted until it is demonstrated that these species are making use of restored habitat that was previously unoccupied by the species and that the temporary loss of currently occupied habitat will not have negative impacts on the species. For example, restoration of full the full tidal range in the western portion of Area B—which would require extensive temporary loss and minor permanent loss of tidal marsh and salt panne habitats which are currently occupied by Belding's Savannah sparrow—will not occur until it has been demonstrated that the species is actively using restored tidal marsh and salt panne habitats in Area A and that the temporary and permanent loss of habitat in Area B will not have negative impacts on the species. As with other special-status species, focused monitoring efforts will be implemented to ensure that populations of these species either remain at pre-restoration levels or increase in size, and appropriate management efforts will be implemented if populations of these species decline in size.

In addition to the species discussed above, restored habitats at the BWER have the potential to attract a number of additional special-status plant and wildlife species known to occur in the region. New populations of special-status species will be subject to focused monitoring efforts aimed at identifying trends in population size and habitat use and informing the need for active management of the species or habitats in which they reside. To the extent feasible, monitoring of special-status species will be conducted using established protocols and will be incorporated into existing regional or state monitoring programs for these species.

3.3.5 Invasive Species

A number of non-native, invasive species currently occur at the BWER. Complete eradication of all non-native species in the Reserve is not feasible; however, restoration objectives include the control of those species considered highly or moderately invasive by the California Invasive Plant Council ("Cal-IPC"; 2013); control of such species will be essential for the long-term development and maintenance of desired vegetation communities and high levels of biodiversity. Controlling invasive species will require appropriate pre- and post-construction measures and monitoring to ensure that existing populations of invasive species are handled appropriately and to avoid new introductions of invasive plants. During the pre-construction phase, populations of invasive species should be identified and prioritized for removal. In areas in which soil will be excavated and reused, it may be necessary to remove invasive species prior to excavation to prevent spreading propagules to other portions of the BWER. For some species which are currently present in high numbers (e.g., pampas grass), this will require the removal of a significant amount of biomass. This biomass will require special handling and disposal following appropriate best management practices to prevent spreading the plants to areas outside of the BWER and to prevent reestablishment at the BWER (see Appendix C and Cal-IPC 2012a, b). Depending on the depth of soil to be placed in upland restoration areas and other areas receiving excavated soils, it may be possible to place excavated soils directly over existing populations of invasive plants. Similarly, it may be possible to dispose of removed invasive plant material by burying it under a thick layer of excavated material. The depth at which invasive plant species must be buried to ensure that they will not resprout varies by species, but is on the order of 3 to 10 feet (0.9 to 3 meters). Burying large amounts of plant material at the site may cause issues with subsidence as the plant material decomposes—this subsidence would have to be quantified and incorporated into the project design.

Because it is not possible to remove all invasive plants from the BWER or from surrounding areas, post-restoration monitoring and removal of invasive species must be an on-going process as new infestations are likely to arise over time. Limiting sources of soil disturbance within the BWER, combined with the use of best management practices when soil disturbance is required, will help reduce the potential for new invasions. Control methods for selected invasive species currently at the BWER are presented in Appendix B.

In addition to invasive terrestrial plants, there is potential for establishment of invasive aquatic plant and wildlife species. The potential for introduction of invasive aquatic plants will be limited by high salinity levels in aquatic areas throughout the Reserve. However, there is greater potential for introduction of highly invasive aquatic invertebrates such as the New Zealand mudsnail (*Potamopyrgus antipodarum*). Strict best management practices related to the movement of equipment and materials in and out of the BWER will be required to prevent the introduction of invasive plant and wildlife species. This will be particularly important for equipment and materials that have been used in wetted environments prior to entering the Reserve. A general list of potential best management practices to be employed during the restoration is provided as Appendix C.

3.3.6 Public Access and Infrastructure

A wide range of infrastructural improvements will be necessary to accommodate planned levels of public access. The majority of planning related to public access and infrastructure is beyond the scope of this Conceptual Plan and will be developed in further detail by the project design team; however, some discussion of the location of public access relative to sensitive habitats is appropriate here. Public education and access to unique habitats is a key goal of the proposed restoration, and as such, it will be important to provide opportunities for public access into the restored habitats. However, public access to these habitats should be limited to well-defined trails and boardwalks. These features should be designed to accommodate natural flows of foot traffic through the BWER—this will help prevent visitors from deviating from the established paths and creating social trails in sensitive habitats. It may be necessary to include wildlife-friendly fencing, plantings of spiny native plants (James and Zedler 2000), or other elements designed to prevent human access to sensitive habitats. Similarly, seasonal closures may be necessary in certain parts of the Reserve to accommodate the life history of sensitive wildlife species (e.g., during the breeding season for some birds) or to prevent damage to trails during the rainy season.

3.4 Restoration Phasing

The complexity of a restoration of this size as well as the presence of sensitive habitats and species necessitates careful staging. The restoration will occur in three phases, each requiring multiple years to complete. Phasing will be designed to allow for evaluation of biologic (including special-status species), hydrologic, and geomorphic performance of early restoration stages and subsequent refinement of the restoration design for later stages. Details of restoration staging can be found in the technical memoranda prepared by ESA PWA with contributions from Psomas and Associates and Group Delta, Inc. (PWA 2010; ESA PWA 2012a). The final staging will require further development to incorporate the biological components of the restoration at appropriate stages and to accommodate changes to the latter stages of the restoration based on the outcome of the first stages. As noted in Section 3.3.4, phasing for many portions of the restoration will be dependent on the demonstrated use of restored habitats by specific special-status species (e.g., Belding's Savannah sparrow) and the determination that restoration activities will not have negative impacts on such species.

3.5 Restoration Approach

The following sections outline the general approach to the restoration based on the details of the proposed restoration alternative (PWA 2008). As noted previously, the final restoration plan is still in development, and it is likely that some aspects of the approach presented below will be changed based on funding constraints, guidance form the CEQA/NEPA analysis, and regulatory requirements. The information provided here is provided for contextual purposes only and is not intended for use in assessing impacts associated with the restoration.

3.5.1 Ballona Creek Realignment

Ballona Creek will be realigned between the Culver Boulevard bridge and the southwest corner of Area A. The creek will be realigned to accommodate two meander bends, and the restored channel banks will be graded to create a gentle sloping transition into mudflat and low marsh habitat. Existing levees will be removed and the channel will no longer be confined to a rigid alignment except where necessary to protect infrastructure.

In these areas, setback bank armoring (buried rock protection) will be used to prevent excessive channel migration. In other areas, the channel will be allowed to migrate in response to erosion and deposition dynamics typical of natural estuaries. The new alignment would extend Ballona Creek into both Areas A and B.

3.5.2 Area A

Restoration of Area A will include excavation of a large portion of the fill material placed there during the construction of Marina del Rey. The area will be re-graded to create a gentle transition from upland habitats along the northern edge of Area A into vegetated marsh and mudflat habitat along the banks of the restored Ballona Creek. Soil from the excavation will be used in the construction of levees and to restore upland habitats and transition zones in Area B. A network of sinuous, branching tidal channels connected to Ballona Creek will be created in the restored wetlands to allow for full tidal activity.

Depressions will be created in the high marsh and transition zones and in uplands to encourage the formation of seasonal wetland and salt panne habitat. The upland edge of Area A will be raised and/or re-graded to create a flood protection levee to replace the Ballona Creek levee. The levee will separate the restored wetlands in Area A from Marina Ditch. Marina Ditch may also be realigned to meander through restored marsh habitat in the northeastern edge of Area A; however, Marina Ditch would maintain its current connection to Marina del Rey and would not be connected to Ballona Creek.

3.5.3 Area B

Restoration of Area B includes a construction of a new levee north of Culver Boulevard, creation of restored wetlands and upland peninsulas between the Culver Boulevard levee and the realigned channel, restoration of full tidal activity in the existing muted tidal marsh in the western portion of Area B, and restoration of the managed wetland and the upland habitat behind Culver Boulevard and Jefferson Boulevard. The presence of a number of special-status plant and wildlife species in the tidal marsh and dune habitats in Area B will necessitate careful planning to avoid impacts to these species. Restored tidal marsh and salt pan habitats in Area A should demonstrate suitability for sensitive species (e.g., Belding's Savannah sparrow) prior to initiation of restoration activities in currently occupied habitat in Area B. Phasing will need to be developed and implemented in conjunction with permit requirements outlined by the respective regulatory agencies with jurisdiction over each habitat type or species.

Culver Boulevard Levee

The levee will tie in with the existing Ballona Creek levee at the Culver Boulevard bridge and continue through the upland habitat along Culver Boulevard, tying in with the dunes and existing Ballona Creek levee in the western portion of Area B. Levee slopes will provide a gradual upland transition zone. The new Culver Boulevard levee will replace the existing Ballona Creek levee and provide flood protection for Culver Boulevard and areas to the south. Existing roads and underground utilities within the southern portion of the Culver Boulevard road embankment will not be affected. The new levee will allow for future relocation of Culver Boulevard to the top of the levee and through the upland area between Culver Boulevard and Jefferson Boulevard.

Upland Peninsulas and Wetland Habitat Restoration

Two upland habitat peninsulas will be created north of the new Culver Boulevard and will serve as high tide refuge for wildlife along the south side of the Ballona Creek channel. The peninsulas will have a gently sloping transition into tidal marsh and mudflat habitat along the restored Ballona Creek channel. The upland peninsulas will be created using soil excavated from the restored wetlands in Area A. Land around the peninsulas will be gently graded toward the Ballona Creek channel to provide an extensive area for the development of tidal marsh vegetation and mudflat habitat.

West Area B Full Tidal Wetland Restoration

Full tidal activity will be restored to the existing managed muted tidal wetland habitat in the western portion of Area B by removing the existing tide gate and lowering or removing the existing Ballona Creek levee. Initiation of restoration should follow establishment of suitable tidal marsh and salt panne habitat in Area A and demonstrated use of these habitats by Belding’s Savannah sparrow. The existing channel would be enhanced by excavating side channels to transition into existing wetland habitat. After restoration to full tidal activity, this area will support the full range of tidal marsh habitats, from mudflat to upper marsh and an upland transition zone. The existing salt panne and large areas of pickleweed vegetation are expected to revert to mudflat habitat after full tidal activity is restored. Salt panne habitat will be re-created in the gently sloping high marsh and transition zone habitats along the new Culver Levee and along the perimeter of the restored wetlands in Area A. Existing transition zone and dune habitats in the western portion of Area B will be retained; however, portions of these areas may be inundated during extreme high tides and flood events. The existing gas wells in the western portion of Area B will be either removed or protected in-place prior to the restoration, and portions of these areas will be lowered and restored to wetland habitat.

The existing salt panne habitat and pickleweed vegetation in Area B are home to a population of Belding’s Savannah sparrow which is a California state-endangered species. Given the importance of the existing salt panne habitat and pickleweed vegetation for this species, it will be important to demonstrate that created salt panne habitat and pickleweed vegetation in Area A will support the population of Belding's Savannah sparrow prior to implementing portions of the proposed restoration in Area B.

Managed Wetland and Upland Restoration South of the Culver Boulevard Levee

A culvert with a self-regulating tide gate will be installed under Culver Boulevard to restore some tidal activity to the existing managed muted-tidal wetland in the southern portion of Area B. The tidal range in this area will be managed to accommodate the eucalyptus grove at its southern edge; the eucalyptus grove will be maintained for monarch roosting and will eventually be replaced with suitable native trees. Tidal channels in this area would be restored to increase tidal flow into the wetlands, up to the elevation necessary to prevent salinity- and hydrology-related impacts to the eucalyptus grove. A second tidal connection will be created under Jefferson Boulevard and the new Culver Boulevard levee to restore tidal flows to the existing managed non-tidal wetland in the southeastern portion of Area B. Tidal channels would also be restored in this area to increase tidal flow into the wetlands. Tide gates would allow for a full range of tidal activity, up to the level acceptable for flood management. The edges of tidal channels will be planted with appropriate species such as pickleweed to stabilize the banks.

An area of brackish marsh will be created between the restored tidal wetlands in the southeastern portion of Area B and the existing Freshwater Marsh. A portion of the outflow from the Freshwater Marsh will be routed through brackish marsh, mixing with tidal inflows from the restored tidal marsh. Tide gates at the inlet to the tidal marsh and control structures at the outlet of the Freshwater Marsh will provide the opportunity to regulate the amount of fresh and/or saline water entering the brackish marsh, thereby providing some ability to control salinity levels and other biologically important aspects of water chemistry such as dissolved oxygen levels.

Soil excavated to restore wetlands in Area A will be placed in the area between Culver and Jefferson boulevards within an existing mosaic of uplands and wetlands. Created and existing upland habitat will be established or restored through a combination of invasive species removal and planting of appropriate native species. Seasonal wetlands (e.g., vernal pool habitat) may be created within portions of the upland habitat.

3.5.4 Area C

Restoration in Area C will focus on enhancing upland habitats and the development of an interpretive visitor center to be developed by the project design team. Soil from the excavation in Area A will be used to increase elevations in Area C. Restored upland habitat will be replanted with native species typical of coastal sage scrub and native grassland. Although restoration activities for this area are still being refined, there is potential for seasonal wetland habitat to be created in the eastern portion of Area C, with upland areas graded to allow rainfall to flow into the seasonal wetlands. Small treatment wetlands may also be constructed along the northeastern boundary of Area C to treat off-site runoff that flows through this area. Additional treatment wetlands may be created to treat run-off from the interpretive visitor center, and other structures or impervious surfaces to be included in the BWER.

3.6 Planning for Climate Change

Numerous public agencies have prepared policies and guidance for addressing issues related to global climate change with particular emphasis on rising sea levels and increases in storms and other extreme weather events (e.g., California Climate Action Team 2010, 2013; SLC 2009; CDFG 2011). Most guidance focuses on adaptive capacity, or the ability of a system to change in response to rising sea levels. Relative to more developed areas, natural habitats such as the Ballona Wetlands generally have greater adaptive capacity in that organisms are relatively mobile and habitats can shift, whereas anthropogenic structures such as buildings and roads cannot be easily relocated.

Because our understanding of the potential effects of global climate change is limited, it is difficult to plan the effects that climate change may have, and most planning is aimed at ameliorating the effects of rising sea levels. Bergquist et al. (2012) prepared an extensive analysis of the implications of climate change for the proposed restoration at the BWER. Their analysis focused on the effects of rising sea levels and increases in major storm events on two restoration alternatives, including the proposed restoration alternative which is the focus of this Conceptual Plan. Their analysis indicated that the BWER will be particularly vulnerable to sea level rise due to its low-lying coastal position and that the effects of rising sea levels are likely to outweigh the effects of increased frequency and severity of major storm events.

To accommodate rising sea levels, the proposed restoration alternative incorporates gentle slopes in tidal wetland and transition habitats with the intent that such gradual slopes will allow tidal marsh habitat to move landward as sea levels rise. As sea levels rise, it is expected that the sequence of tidal marsh, transition, and upland habitat will shift upslope. This will result in a decrease in upland habitat, but will enhance the ability of tidal marsh habitat and its associated wildlife to persist. This use of broad transitional slopes between wetland and upland habitats is consistent with the State Coastal Conservancy’s Climate Change Policy (SCC 2011).

More complex changes in ecological processes are expected with global climate change; however, the extent of our knowledge of climate change and associated adaptation strategies is limited and makes more than generalized predictions impossible. It is likely that a changing climate will result in changes in the distribution of plant and wildlife species as well as the timing of growth and reproduction of these species. The timeframe under which such changes may occur is unclear, as are the implications for the proposed restoration at the BWER. As such, the use of adaptive management strategies will play an important part in managing the BWER in response to climate change. Given the uncertainty in our understanding of the potential effects of climate change, it will be important to be able to address unexpected issues such as deviations in expected habitat development, shifts in the ranges of both native and non-native species, increases in the prevalence of diseases or pest species, and other challenges. The use of an adaptive management approach will allow the land manger to address such challenges and to find solutions consistent with the goals of the restoration.

4.0 MONITORING, PERFORMANCE GOALS, AND ADAPTIVE MANAGEMENT

The monitoring program for the BWER will be designed to evaluate the progress toward achieving restoration goals and to inform the need for adaptive management during the lifespan of the restoration. Because the restoration is not being conducted as mitigation or under mandate from any state or federal judicial body or regulatory agency, the performance goals and associated monitoring may differ from those of standard mitigation projects. That said, many aspects of the restoration will be subject to regulatory oversight, and additional performance goals and associated monitoring requirements may be required by the regulatory agencies. In general, however, performance goals for the restoration will not focus on specific acreages or specific species, but will focus broadly on habitat development, species composition, and, ecosystem function (Short et al. 2000; Zedler and Callaway 2000; Thom et al. 2010). Moreover, the performance goals will be open to revision based on improvements in our understanding of habitat development or species requirements, including lessons learned during the early phases of the restoration or from other similar restoration projects being conducted in the area.

In addition to being broad-based and adaptable, the monitoring program will be of sufficient length to capture long-term trends in habitat development and use by wildlife species—this could be on the order of a decade or longer (Zedler and Callaway 1999). For most variables discussed in this Conceptual Plan, a monitoring period of 10 years is recommended. A 10-year monitoring period was chosen to balance funding limitations with the need to document long-term trends in habitat development. Although a 10-year monitoring period is recommended, it is understood that some aspects of habitat development and function may not be evident within the first 10 years, and for these variables it may be necessary to extend the monitoring period by an additional decade or more.

The goal of monitoring will be to document trends in habitat development and assess progress toward meeting restoration objectives. For cases in which the course of habitat development is relatively uncertain or for monitoring parameters which may be highly variable, it may be useful to assess performance relative to conditions in suitable reference habitats in the region. For more well-understood parameters, the use of absolute performance goals may be sufficient. It should be understood that some level of uncertainty will always be present, and all of the performance goals presented here or those to be developed for the HMMP may require modification based on an improved understanding of habitat development, ecosystem function, or species requirements (Atkinson et al. 2004; Thom et al. 2010; Fischenich et al. 2011). Furthermore, habitat development is an on-going process that is likely to extend well beyond the prescribed monitoring period. Some aspects of the monitoring program will have a definitive end point (i.e., when performance goals have been reached). However, given the highly modified nature of the watershed supporting the BWER and the constraints imposed by the surrounding development, it is likely that the restored wetlands will never be fully sustainable and will always require periodic maintenance (Callaway and Zedler 2004). As such, some level of monitoring and management will be required indefinitely into the future (e.g., monitoring for invasive species or human disturbance).

Finally, the monitoring program will be designed to be simple, cost-effective, and achievable (Atkinson et al. 2004). Because of the potential length of the monitoring period, monitoring should be designed using standard methods and equipment such that monitoring can be conducted by a range of individuals or organizations, including citizen-scientist volunteers where appropriate, with only minimal training required. Monitoring will focus on the major biotic and abiotic factors that drive habitat development and ecosystem function—in particular, those factors that can be manipulated and managed or those parameters that can be used to gauge habitat development and ecosystem function (Thom et al. 2010). Sampling procedures and analyses of monitoring results will be developed to appropriately reflect the level of accuracy achievable with each sampling procedure and the sample size achievable for each monitoring parameter. The end result of the monitoring program will be a simple, clear picture of habitat development at the BWER in terms that can be understood by scientists, regulators, and laymen alike.

It should be noted that because the restoration plan is still in development, many of the details necessary for developing strict monitoring protocols and performance goals are lacking. For example, it has yet to be determined which habitats will be planted and which will be allowed to revegetate naturally. Habitats that are planted would be expected to develop at a more rapid pace than habitats that are allowed to revegetate naturally. As such, it is difficult to develop strict performance goals related to vegetation establishment. The same is true for other aspects of the restoration that are still in development. The information provided in this Conceptual Plan is intended to guide the development of such details; however, many other factors beyond the scope of this document (e.g., funding) must also be considered. As such, many of the elements treated in the following sections are conditional and are subject to change based on the form of the final restoration plan, input from the CEQA/NEPA analysis, and regulatory requirements.

4.1. Developing the Monitoring and Adaptive Management Program

As noted in the Introduction, the purpose of this Conceptual Plan is to outline the general form of the restoration and guide the development of more detailed elements of the final restoration plan such as the grading plan, the planting/landscape plan, the operations and management plan, and the HMMP. Among these plans is the development of a more detailed HMMP based on the guidance provided in this Conceptual Plan, the findings of the CEQA/NEPA analysis, regulatory requirements, and the final plan for restoration staging and implementation. The HMMP will build directly from the guidance developed in this Conceptual Plan, with modifications as necessary. The HMMP will include a timeline for the implementation of the monitoring program based on the final plan for staging and implementation. Although a monitoring period of 10 years is recommended here, the final length of the monitoring period will be based on the phasing to be implemented during the restoration. The HMMP will also include a work plan or schedule for long-term monitoring after the site has achieved the performance goals outlined here and in the HMMP. In addition to a detailed monitoring schedule, the HMMP will provide specific protocols for monitoring, including sample design (e.g., number of replicates, locations for sample points, transects, etc.), sampling methods to be implemented, and statistical methods for analyzing the data.

4.1.1 Reference Sites

As noted above, the use of reference sites may be useful for monitoring parameters which are highly variable, such as for biological parameters closely linked to local or regional climates (e.g., plant response to rainfall levels). The use of reference sites may also be useful for habitats for which the course of development is not well understood (e.g., salt panne habitat). The decision to use reference sites as a control for highly variable monitoring parameters or parameters tightly correlated with local weather and climate patterns should be made prior to the initiation of the monitoring program, with significant input from the Scientific Advisory Committee and the CDFW or other managing agency.

The selection of appropriate reference sites is an important component of the monitoring program, as the use of inappropriate reference sites could lead to misinterpretation of habitat development and ecosystem function and could result in a false sense of success or failure. The use of reference sites to gauge the progress of restoration efforts is generally limited by the availability of suitable sites in the region, the similarity of potential reference sites to the restoration site, and the funding available for monitoring (Neckles et al. 2002). The use of tidal wetland reference sites in southern California is further limited by the availability of natural, undisturbed tidal wetlands. Many of the potential reference wetlands in southern California are either highly degraded or are the subject of on-going restoration efforts and may not function in the same way as undisturbed wetlands in the region. Conditions observed at such sites may reflect a rehabilitated condition rather than pre-disturbance conditions (Spencer and Harvey 2012). However, given the highly modified nature of the watershed supporting the BWER and the constraints imposed by the flood control aspects of the project, it is not possible to restore wetlands at the BWER to their pre-disturbance condition, and a rehabilitated condition may be the most achievable outcome for the restoration. As such, restored reference sites may be appropriate given the general lack of pristine reference sites in the region. In general, any site with remnant or restored wetlands which demonstrate desirable qualities such as high diversity of native species or populations of rare plants or wildlife should be considered as a potential reference site. Despite the general lack of high quality estuarine wetlands and associated habitats in southern California, a number of potential reference sites occur there, including Alamitos Bay in Los Angeles County; Tijuana Estuary, San Dieguito and Poseidon wetlands, and Peñasquitos Lagoon in San Diego County; Upper Newport Bay in Orange County; Mugu Lagoon and Ormond Beach in Ventura County; and Carpinteria Salt Marsh in Santa Barbara County.

A number of authors have put forth recommendations for selecting reference sites (e.g., Short et al. 2000; Neckles et al. 2002; Thom et al. 2010). Horner and Radaeke (1989; *in* Thom et al. 2010) recommend that the following elements be addressed when determining the similarity of potential reference sites to the restoration site:

- Ecological functions
- Climate and hydrology
- Anthropogenic disturbances
- History of and potential for future management actions
- Size, morphology, water depth, wetland zones and their proportions
- Vegetation types
- Soils and non-soil substrates
- Access by fish and wildlife

Short et al. (2000) recommend using principal components analysis ("PCA") to select appropriate reference sites. Their site selection was based primarily on the geomorphological setting and structural components of the wetland type in question. This approach may be feasible for the BWER given the availability of basic data for wetlands in the region. That said, the pool of potential reference sites may be too limited to warrant such an analysis, and it may be more appropriate to select reference sites based on anecdotal or observational evidence of similarity to the BWER.

Given the limited area and degraded condition of tidal wetlands remaining in southern California, it is unlikely that a single "ideal" reference site will be available. Moreover, it is unlikely that any given reference site will have all of the habitat types and other components necessary for the monitoring program at the BWER. As such, separate reference sites or groups of reference sites may be necessary to accommodate all of the monitoring needs at the BWER. Ideally, more than one reference site would be used for each monitoring parameter as this can improve the power of statistical comparisons (Neckles et al. 2002). In addition, it may be necessary to use different reference sites for each habitat type at the BWER given that many potential reference sites will not contain the full suite of habitat types that are planned for the BWER. However, financial and practical considerations constrain the potential for using multiple reference sites. One way to reduce the cost of monitoring may be the use of data from reference sites which are currently being monitored as part of existing restoration projects. This would require that monitoring parameters and protocols be standardized and that monitoring timeframes be compatible. For example, the ongoing monitoring programs at San Dieguito Wetlands or the South Bay Wetlands in San Diego County could be incorporated into the monitoring program at the BWER. The use of citizen-scientist volunteers may be another way to reduce the cost of monitoring at multiple reference sites.

4.1.2 Monitoring Parameters, Performance Goals, and Adaptive Management

<u>Monitoring Parameters</u>

A wide range of variables have been monitored at wetland restoration sites around the country; however, most authors recommend focusing on variables related to ecological structure and function (Callaway et al. 2001; Neckles et al. 2002; Atkinson et al. 2004; Thom et al. 2010). Ideally, many parameters would be monitored within each habitat at the BWER. In reality, however, most restoration projects, including the restoration of the BWER, have limited funding available for monitoring. Given this constraint, most authors recommend focusing on the core variables affecting habitat development and function and the use of indicators of habitat function such as the development of wetland-associated animal communities (Short et al. 2000). Atkinson et al. (2004) recommend that monitoring variables (1) be relevant to restoration goals and potential management actions, (2) have a strong scientific foundation, (3) be measureable and statistically rigorous, (4) be compatible with existing monitoring and data collection programs, and (5) be easily understood and interpreted.

Extensive lists of potential monitoring variables are provided by Atkinson et al. (2004), Lafferty (2005), Thayer et al. (2005), and Callaway et al. (2001), among others. The monitoring variables presented in the following sections are based on (1) the basic ecological drivers of habitat or community development (or surrogate indicators), (2) the restoration objectives for each habitat (e.g., use by wetland-associated birds), and (3) the variables which are more easily manipulated for management purposes. Within each habitat, there are many potential variables to monitor; the variables chosen for each habitat represent the minimum level of monitoring necessary to gain a basic understanding of the development of biotic communities at the BWER. Given sufficient funding, it may be desirable to include additional variables in the monitoring program. Moreover, additional monitoring variables may be necessary for adaptive management of specific habitats (Neckles et al. 2002). Such additional variables are outlined the adaptive management sections for each habitat type; however, it is not possible to predict the full range of potential impediments to habitat or community development, and it may be necessary to include additional variables not addressed in this Conceptual Plan.

As noted above, it may be useful to monitor for some variables at both the BWER and at one or more reference sites. If reference sites are used, the monitoring protocols should be standardized such that they are the same for both the reference site and the BWER. To the extent feasible, sample sizes should also be the same. Because of the added expense involved in monitoring at both the BWER and at one or more reference sites, it may be desirable to use reference sites that are currently being monitored by other groups. Data sharing or other means of pooling monitoring resources can reduce the time and effort involved in monitoring, thereby reducing the overall cost of the monitoring program. However, data sharing with other monitoring programs may require some modification to the monitoring program outlined in this Conceptual Plan. To the extent feasible, the final monitoring program should be designed such that the data collected is can be shared with the Southern California Wetlands Recovery Project or other regional monitoring programs.

Performance Goals

The restoration efforts at the BWER differ from many other restoration projects in that the restoration is voluntary and not in response to regulatory requirements. Restoration efforts undertaken as required mitigation are often subject to rigid success criteria aimed at determining the success or failure of the project. In this document, the term “success criteria” has been purposefully replaced with the term “performance goals” to avoid creating the impression of a rigid framework for assessing the project’s performance and preemptively determining the success or failure of the restoration (Zedler 2007; Zedler and Callaway 2000). That said, some aspects of the restoration may be subject to regulatory requirements, and the performance goals presented here are subject to change based on the results of the CEQA/NEPA analysis and regulatory requirements.

Performance goals developed for the monitoring program at BWER are based on the primary ecological drivers of habitat development and function (e.g., frequency of tidal inundation for salt panne habitat), the characteristic expression of such ecological drivers (e.g., lack of vegetation for salt panne habitat), and the primary values of the habitat (e.g., bird foraging for salt panne habitat). In some cases, performance goals are based on a more easily monitored surrogate for one or more of these factors. For example, the use of mud-flat habitat for foraging by wading bird species should be correlated with the development of a benthic invertebrate community and may serve as a reasonable surrogate for monitoring the benthic invertebrates.

The use of performance goals relative to conditions at reference sites may provide some ability to overcome uncertainties related to habitat development, of which there are many, and to account for stochastic events which may affect plant and animal communities and ecosystem function at a regional scale. The performance goals presented here are based on our understanding of the development of biotic communities and experiences with other restoration projects in southern California.

Adaptive Management

Adaptive management of habitat development in the restored wetland and upland areas will require frequent monitoring during the initial years to identify and correct any problems in the restoration design. However, some trends in habitat development may not become apparent for many years, and long-term monitoring will be necessary. It is not possible to predict the full range of potential restoration outcomes and associated adaptive management scenarios, and as such, the adaptive management triggers and actions presented in the following sections should be treated as a guide only.

Triggers for adaptive management actions should be based on significant deviation from or a lack of progress toward achieving the performance goals outlined for each monitoring parameter coupled with an evaluation of the trajectories of habitat development or directions of change. For many aspects of biotic community development, it may take several years for trends to become apparent, and changes in management should be delayed until sufficient time has elapsed for trends to become apparent. If it is determined that progress toward performance goals is not measurable or that the habitat appears to be progressing toward an alternative state, an evaluation of the causes involved and the trend toward meeting performance goals should be undertaken to determine whether intervention or mid-course corrections are warranted. In some cases, habitat development may be on track to meet long-term performance goals and no actions may be warranted—in these cases, it may be appropriate to modify the performance goals based on new developments in our understanding of the development of biotic communities. In other cases, it may be determined that additional monitoring parameters are necessary to determine the cause of poor performance. Once the causes of poor performance are identified, appropriate changes in management should be investigated and implemented. Any modifications implemented as a result of this process should be subject to quantitative monitoring and analysis specifically designed to evaluate the effectiveness of such modifications or changes in management.

For some aspects of habitat or biotic community development, intervention or mid-course corrections may be minimal in scale. For instance, if invasive species become a problem, increased management efforts or new management techniques may be necessary. However, some aspects of habitat or biotic community development may require more significant changes. For instance, if salt panne or seasonal wetland habitats fail to meet hydrology performance goals, changes to the grade of the site may be necessary. Similarly, if fish die-offs occur due to low dissolved oxygen levels, modification of tidal circulation patterns may be necessary. Any actions requiring grading or other major site alterations should receive increased scrutiny before implementation. If it is determined that such changes will cause unacceptable disturbances to other habitats or animal populations at the BWER, it may be necessary to reevaluate the restoration goals. All decisions related to adaptive management, including changes in management activities, alteration of the site, shifts in target habitats or performance goals, and the rationale for each decision, should be documented in a central location. This is particularly important given that numerous individuals will be responsible overseeing the operation of the Reserve during its lifetime. Recording management decisions in a central location will provide future land managers with an understanding of the actions of previous land managers, thereby providing an improved basis for making future management decisions.

Special-Status Species

As noted in Section 3.3.4, special-status plant and wildlife species will be subject to focused monitoring efforts aimed at identifying trends in population size and habitat use and informing the need for active management of the species or habitats in which they reside. To the extent feasible, monitoring of special-status species will be conducted using established protocols and will be incorporated into existing regional or state monitoring programs for these species. A separate monitoring plan will be developed for each special-status species or group of special-status species. Where possible, monitoring for special-status species will be integrated with regular habitat monitoring; however, for some species it may be necessary to modify monitoring protocols or to adjust the timing of monitoring events to coincide with important life stages of the species in question. All monitoring and management of special-status species will conform to the policies and guidelines set by the CDFW, CNPS, or other agency or organization with jurisdiction over the species or their habitats.

4.1.3 Data Management and Analysis

Numerous authors highlight the importance of scientifically valid sampling and data analysis and the need for good data management (Atkinson et al. 2004; Thom et al. 2010). Good data management includes procedures for quality assurance and quality control and timely reporting of monitoring results (Atkinson et al. 2004). Methods for quality assurance and quality control will be included in the HMMP and will be consistent with existing CDFW protocols. Similarly, data will be collected and analyzed in a manner that allows the data to be stored in existing databases maintained by the CDFW or other natural resource agencies such as the U.S. Army Corps of Engineers ("Corps"), the U.S. Fish and Wildlife Service ("USFWS"), or the NOAA.

Where appropriate, monitoring data will be analyzed statistically. However, Thom et al. (2010) note that rigorous experimental design which evaluates one or more null hypotheses may not be necessary for documenting the development of biotic communities. They also note that the monitoring implemented for most restoration projects is not conducted with the sample size, replication, or controls necessary for rigorous statistical testing. Although rigorous statistical analyses may be appropriate for some aspects of adaptive management in which management actions are empirically evaluated, in general, simple graphs with error bars or similar analyses may be sufficient to interpret trends in the development of biotic communities (Thom et al. 2010). The use of aerial photographs, permanent ground-based photo-monitoring locations, and Geographic Information Systems ("GIS") analyses are also useful methods for assessing habitat development. The ultimate form of the monitoring program and associated analyses will include some combination of all of the above.

4.2 Tidal Marsh

Monitoring and performance goals for tidal marsh focus on low marsh, mid marsh, and high marsh habitat. Tidal channels and mudflat habitat are treated separately in Sections 4.3 and 4.4, respectively.

The primary ecological driver of tidal wetland habitat development is regular tidal inundation and, related to that, the balance between sediment import and export. The establishment of characteristic tidal marsh vegetation is a relatively good indicator of tidal inundation and marsh plain development and will be the focus of tidal wetland monitoring and performance goals; direct observation of tidal inundation may be needed during the early phases of the restoration when vegetation is sparse and zonation patterns cannot be discerned. Additional monitoring and performance goals will focus on a lack of invasive weeds and the use of tidal marsh habitat by a diversity of birds.

4.2.1. Monitoring

Monitoring of tidal marsh habitat will focus on the establishment of native tidal marsh vegetation, a lack of invasive weeds, and use by bird species. Monitoring for vegetation establishment and invasive weeds should commence at the end of the first growing season following the completion of construction. Although the development of tidal marsh habitat is relatively well understood, it may be useful to base performance goals on conditions relative to one or more reference sites, particularly for monitoring of bird use. Potential reference sites include the tidal marshes at Tijuana Estuary in San Diego County, Upper Newport Bay in Orange County, Mugu Lagoon in Ventura County, or Carpinteria Salt Marsh in Santa Barbara County, among others.

Vegetation and Invasive Plants

Vegetation monitoring will be conducted in two phases. The first phase will make use of orthorectified aerial imagery to document the total cover of vegetation during the initial phases of vegetation establishment. Aerial images should be taken in late summer, after growth has slowed, and should be taken during a low tide sufficient to expose the entire marsh surface. The goal of this monitoring is to document the location and rate of vegetation establishment during the early phases of the restoration when vegetation is likely to be sparse. Total vegetation cover can be calculated through GIS analysis of the aerial images. Limited ground-truthing may be required to verify patterns observed in the aerial imagery.

The first phase of vegetation monitoring will be conducted every one to two years until it is determined that vegetation is sufficiently dense to allow for efficient ground-based monitoring—this level should be between fifteen and twenty percent cover. Once it is determined that vegetation composition can be efficiently measured on the ground, the second phase of vegetation monitoring will commence and will consist of a quantitative method along transects running from high marsh to low marsh. These transects may be the same as those used for other monitoring parameters to reduce impacts to the marsh and make monitoring more efficient. The monitoring design will be similar to that used for vegetation monitoring elsewhere in the Reserve and will be designed to capture both the composition of vegetation and cover by individual plant species. During the second phase, vegetation will be monitored annually, near the end of the growing season when plants have put on most of their growth but are still identifiable. Vegetation monitoring will continue for the duration of the 10-year monitoring period.

Although it is expected that regular inundation by salt water will limit the potential for invasion of the mid- and low marsh zones, there is potential for non-native, invasive species of sea lavender or statice (*Limonium* spp., other than *L. californicum*) or cordgrass (*Spartina* spp., other than *S. foliosa*) to become established in these regularly inundated marsh zones. Because of the reduced levels of tidal inundation received by the high marsh, there is greater likelihood for invasion of this zone. Monitoring for invasive species will be conducted on an annual (or more frequent) basis, during late spring when annual weeds are in flower or at other appropriate times related to weed life cycles. Monitoring for invasive species will be conducted for the duration of the 10-year monitoring period and is likely to be necessary for the lifespan of the restoration. Monitoring for invasive species will be conducted throughout the entirety of the tidal marsh habitat and will be aimed at identifying the location and extent of any populations of invasive species listed as “High” or “Moderate” by the Cal-IPC (2013), exclusive of annual grasses. Although it may be helpful for management purposes, it may not be necessary to quantify invasive species populations. Instead, a simple qualitative assessment including the location and approximate extent and severity of the infestation may be sufficient to inform management actions. That said, the effectiveness of management actions should be assessed quantitatively, and this may require baseline quantification of the infestation prior to initiating management actions.

Bird Abundance and Diversity

Monitoring for bird use of tidal marsh habitat will be conducted in conjunction with bird monitoring in other habitats at the BWER and the methods use will be consistent with the methods used elsewhere in the Reserve. Monitoring will be designed to capture (1) the abundance and species richness of birds observed using the tidal marsh habitat and (2) the activities in which the birds were engaged within the tidal marsh habitat (i.e., foraging, nesting, etc.).

Due to the large seasonal variation in bird migration and breeding patterns, monitoring for bird use of tidal marsh habitat will be conducted at intervals throughout the year, with reduced monitoring during the summer breeding period to limit disturbance to breeding birds. Monitoring will be timed to occur during peak periods of bird activity. Because the ecological factors involved in bird use of tidal marsh habitat are based on a complex set of factors extending well beyond the limits of the BWER, this monitoring will be conducted every year during the 10-year monitoring period to capture the full range of variability and to compensate for stochastic events that may affect bird use in any given year. For similar reasons, the use of one or more reference sites will be considered as this will help capture variations in bird use which may be attributable to environmental factors extending beyond the borders of the BWER.

In addition to general bird monitoring, it will be important to conduct species-specific monitoring for Belding’s Savannah sparrow which is known to use existing tidal marsh habitat in Area B. This monitoring will follow established protocol approved by the CDFW (e.g., Zembal and Hoffman 2010). Restoration activities that will disturb habitat within Area B which is currently occupied by Belding’s Savannah sparrow cannot proceed until it is determined that this species is breeding in the restored salt marsh habitat in Area A and that the temporary disturbance of occupied habitat in Area B will not affect the population at the BWER. As such, surveys for Belding’s Savannah sparrow will need to be conducted in both the restored habitat in Area A and the existing habitat in Area B. Following the completion of restoration activities, this species-specific monitoring should continue for as long as the statewide census is in effect. Because of the sensitivity of this species, performance goals and adaptive management triggers related to this species should be developed by or in close coordination with the CDFW.

4.2.2 Performance Goals

As noted above, performance goals for tidal marsh habitat will be based on (1) establishment of native tidal marsh vegetation, (2) low cover of invasive weeds, and (3) use of tidal wetland habitat by a diverse array of birds.

<u>Vegetation and Invasive Plants</u>

Vegetation performance goals should be based on the establishment and high cover of native tidal marsh plant species and low cover of highly invasive species. Tidal marsh vegetation will be established through a combination of natural recruitment and plantings, and as such, the performance of tidal marsh vegetation is likely to be highly variable, particularly in the first several years of the restoration. Variation is also likely to occur within the low, mid- and high marsh zones due to the variable use of natural revegetation versus planting in these different zones. The performance goals outlined below are presented for the habitat as a whole; however, given the likely variability of plant performance in the initial years and between marsh zones, it may be appropriate to develop and apply these goals to the three marsh zones independently.

Table 1. Tidal Marsh Vegetation and Invasive Plant Performance Goals

Monitoring Year	Performance Goals
1 – 3	**A.** Canopy cover may be low, but native salt marsh species should show signs of establishment and spread. **B.** Cover of invasive species listed as “High” or “Moderate” by the Cal-IPC, exclusive of annual grasses, should remain low.
4 – 7	**A.** Canopy cover of native salt marsh species should be relatively high, approaching 75% or greater by the end of Year 7, and should show signs of significant natural recruitment. **B.** Vegetation should include a mix of native species, although one or two native species may dominate. **C.** Cover of invasive species listed as “High” or “Moderate” by the Cal-IPC, exclusive of annual grasses, should remain low.

Table 1. Tidal Marsh Vegetation and Invasive Plant Performance Goals

Monitoring Year	Performance Goals
8 – 10	**A.** Canopy cover of native salt marsh species should be nearly complete. **B.** Vegetation should include a mix of native species, although one or two native species may dominate. **C.** Cover of invasive species listed as "High" or "Moderate" by the Cal-IPC, exclusive of annual grasses, should remain low.

Bird Abundance and Diversity

Performance goals for bird use of restored tidal marsh habitat will be based on high abundance and species richness of tidal marsh-associated birds observed using tidal marsh habitat for foraging, nesting, etc. Because of the large number of factors involved in the use of a site by birds, it may be useful to assess bird use of tidal marsh habitat at the BWER relative to bird use of tidal marsh habitat at one or more suitable reference sites.

Table 2. Tidal Marsh Bird Performance Goals

Monitoring Year	Performance Goals
1 – 3	**A.** A variety of tidal-marsh associated bird species should be observed foraging in the restored tidal marsh, although the diversity and abundance of birds may be lower than observed prior to the restoration.
4 – 7	**A.** Species richness and abundance of tidal marsh-associated birds should each be within pre-restoration levels and should be increasing with each successive year. **B.** Birds should be observed both foraging and demonstrating territorial behavior within the restored tidal marsh habitat.

Table 2. Tidal Marsh Bird Performance Goals

Monitoring Year	Performance Goals
8 – 10	**A.** Species richness and abundance of tidal marsh-associated birds should each be greater than pre-restoration levels; however, annual increases may slow relative to increases observed in Years 4 – 7. **B.** Birds should be observed both foraging and demonstrating territorial behavior within the restored tidal marsh habitat. **C.** Successful breeding should be documented for at least some tidal marsh-associated bird species.

4.2.3 Adaptive Management

The primary ecological factor involved in the development of tidal marsh vegetation is hydrology—regular inundation by tidal waters (Sharitz and Pennings 2006). Additional factors involved in the establishment of tidal marsh vegetation include sediment characteristics (e.g., soil texture, pH, nutrient levels, organic matter content, soil contaminants, etc.), rates of erosion or sedimentation, and the availability of plant propagules. The development of tidal marsh bird communities is primarily related to vegetation composition and structure, the availability of suitable food sources such as seeds, benthic invertebrates, or fish, and the presence of bird predators (Keddy 2010).

Performance goals for tidal wetland habitat focus on the development of appropriate vegetation and use by birds. Because restoration in each zone of the tidal marsh will rely on some combination of planting, seeding, and natural revegetation, differences are expected in the trajectory of vegetation development within each zone. Marsh zones which are planted should be expected to develop quicker than zones which rely on natural revegetation. For marsh zones which are planted, trends in the development of vegetation should be apparent within three to five years. For marsh zones which rely on natural revegetation, trends in the development of vegetation may take five or more years to become apparent. Use of the tidal marsh areas by bird species is expected to occur immediately following the restoration of tidal action and to evolve over time in conjunction with the development of tidal marsh vegetation. As such, trends in the use of tidal marsh habitat by birds should be apparent within three to five years following the restoration of tidal activity.

If tidal marsh vegetation does not demonstrate a suitable trajectory toward achieving performance goals within the expected timeframe for trends in vegetation development to become apparent, an assessment of overall trends in vegetation development will be conducted to determine whether additional studies or changes in management are warranted. If it is determined that the development of tidal marsh vegetation is on track to meet long-term performance goals, modification of performance goals based on an improved understanding of habitat development may be the most appropriate course of action. However, if it is determined that the development of marsh vegetation is not on track to meet long-term performance goals, the causes of this lack of progress toward meeting performance will be identified and potential solutions will be investigated. Potential causes for a lack of progress toward meeting performance goals are likely to be related to soil physical or chemical properties or hydrological regime, and these should be the first targets for study. Potential corrective actions may include additional planting of tidal marsh species to increase the rate of vegetation establishment, the introduction of soil amendments to alter soil physical or chemical properties, or the addition of temporary irrigation or modifications to the tidal regime to improve plant growth or hinder the establishment of invasive species. If invasive species become a problem, management actions such as physical removal or chemical control may be necessary.

If it is determined that bird use of tidal marsh habitat does not demonstrate a suitable trajectory toward achieving performance goals within the expected timeframe for trends to become apparent, an assessment of overall trends in bird use will be conducted to determine whether trends are specific to the BWER or occur at a regional scale. If it is determined that the poor performance is specific to the BWER, additional studies or changes in management may be warranted. Potential causes for a lack of progress toward meeting performance goals are likely to be related to vegetation composition or structure, the absence of suitable food sources, or the presence of bird predators. Potential corrective actions may include modifications to the management of vegetation, soil properties, or tidal regimes to create appropriate habitat structure for birds or to promote increased use of tidal marsh habitat by benthic invertebrates or fish species. Predator management may also be required and is discussed in further detail in Section 4.12.4.

4.3 Subtidal and Intertidal Channels

The extent of subtidal and intertidal channels will be determined primarily by the initial design and will be modified over time based on the rate of tidal flow entering the wetlands from Ballona Creek. Tidal channels are expected to evolve to some degree over time based on sediment loads, storm events, etc. Although some migration and contraction or expansion of tidal channels is expected and desired, excessive movement and contraction or expansion could negatively affect the flood control aspects of the project or the development of tidal marsh habitat. Monitoring and performance goals will be based on the location, width, and depth of tidal channels relative to the originally designed specifications and the expected development of tidal channels.

In addition to providing some level of flood control protection, tidal channels provide the connection between the open ocean, Ballona Creek, and tidal marsh habitat at the BWER. These tidal channels will be the primary route through which the introduction of benthic invertebrates, fish, and other aquatic organisms will occur. Colonization of mudflat habitat by benthic invertebrates will provide some evidence of this biological function of the tidal channels. A diverse array of fish species and functional guilds in tidal channels will provide an indication of aquatic habitat quality in the tidally influenced portions of the Reserve. In addition to measurements of tidal channel structure, biological monitoring parameters and performance goals will focus on use of tidal channels by fish. Given the high seasonal and annual variability in fish populations, the use of one or more suitable reference sites may be useful for this monitoring parameter. Potential reference sites include the tidal wetlands at Tijuana Estuary in San Diego County, Mugu Lagoon in Ventura County, or Carpinteria Salt Marsh in Santa Barbara County, among others.

4.3.1 Monitoring

<u>Channel Morphology</u>

Monitoring for channel morphology should include both analyses of aerial images to document changes in the extent and location of tidal channels and ground-based monitoring to document changes in channel width or depth. Monitoring should occur after the rainy season, when major storms are no longer expected and annual changes in tidal channel morphology are likely to be slower. Aerial images should be analyzed using GIS software to document any changes in the extent and location of tidal channels. Ground-based monitoring should consist of measurements of channel depth and width and the location of the banks at a variety of locations near and far from the channel openings at Ballona Creek. Monitoring will be conducted annually during the 10-year monitoring period; it may be useful to qualitatively monitor changes in channel morphology following major storms, in addition to the annual monitoring. Although the proposed restoration has been designed to avoid accumulation of sediments at the tidal openings to Ballona Creek and at tide gates servicing the managed tidal areas, there is potential for unforeseen changes in sediment loads or related factors to cause long-term accumulation of sediments in these areas. As such, some level of monitoring may be necessary for the lifespan of the restoration.

Fish Abundance and Diversity

In addition to physical parameters, monitoring of tidal channels will also document the abundance and species richness of fish species found in tidal channels at the BWER. Fish monitoring will be conducted annually, during the summer months when fish abundance and diversity are at their peak. Monitoring will occur at high tide and will occur in each major tidal channel servicing the tidal marsh areas. Monitoring will make use of a variety of sampling methods designed to document the full range of fish diversity at the BWER—these methods may include the use of otter trawls, bag seines, gill nets, enclosures, and other methods. The goal of monitoring will be to capture the diversity and abundance of fish species within each guild expected to be present at the BWER, including demersal fish, pelagic fish, and burrow-inhabiting fish.

Water Quality

Dissolved oxygen will be monitored using a data logging device capable of capturing continuous water quality data or by similar methods. Sampling will occur in a wide range of locations within the tidal channel network to gain a clear picture of dissolved oxygen dynamics. Monitoring for dissolved oxygen levels will be conducted for the duration of the 10-year monitoring period as this monitoring will provide useful data on circulation patterns and residence time, data that will be important for adaptive management.

4.3.2 Performance Goals

Channel Morphology

Performance goals for subtidal and intertidal channels focus on excessive sedimentation, large-scale erosion, and major changes in channel geomorphology. The performance goals presented below assume that changes in channel geomorphology will be greater during the initial phases of the restoration, but will stabilize as vegetation colonizes the marsh plain and rates of sedimentation and erosion reach a balance.

Table 3. Tidal Channel Morphology Performance Goals

Monitoring Year	Performance Goals
1 – 3	**A.** Changes in channel extent or location should be within acceptable design limits. **B.** Erosion and scouring within the main channels may be significant in the first years, but should be within acceptable design limits. **C.** Sedimentation within the main channels and at tide gates and openings to Ballona Creek should be within acceptable design limits.
4 – 7	**A.** Changes in channel extent or location should be within acceptable design limits and should be greatly reduced from rates or extents of change observed during the first years. **B.** Erosion and scouring within the main channels should be significantly reduced from rates observed in the first years. **C.** Sedimentation within the main channels and at tide gates and openings to Ballona Creek should be reduced from rates observed in the first years and should be within acceptable design limits.
8 – 10	**A.** Changes in channel extent or location should be within acceptable design limits and should be negligible. **B.** Erosion and scouring should be minimal throughout the marsh plain. **C.** Sedimentation within the main channels and at tide gates and openings to Ballona Creek should be minimal and should be within acceptable design limits.

Fish Abundance and Diversity

Performance goals for fish abundance and diversity are be based on the development of a relatively stable and diverse native fish population. Because of the large number of variables involved in fish population dynamics, many of which may occur outside of the BWER, it may be appropriate to assess use of the site by fish species relative to pre-restoration levels of fish diversity. Alternatively, one or more reference sites may also be used to assess fish use of tidal channels at the BWER.

Table 4. Tidal Channel Fish Performance Goals

Monitoring Year	Performance Goals
1 – 3	**A.** Species richness and abundance of fish should each be within or approaching pre-restoration levels. **B.** No major fish die-offs should occur.
4 – 7	**A.** Species richness and abundance of fish should each be the same as or greater than pre-restoration levels. **B.** Changes in species richness and abundance of fish should show signs of stabilizing. **C.** No major fish die-offs should occur.
8 – 10	**A.** Species richness and abundance of fish should each exceed pre-restoration levels. **B.** Species richness and abundance of fish should be relatively stable. **C.** No major fish die-offs should occur.

Water Quality

Because dissolved oxygen levels are not expected to evolve over time in the same way vegetation might, a static performance goal is recommended for this monitoring parameter. However, given the expected high daily and seasonal variation in dissolved oxygen levels, in may be useful to develop performance goals relative to the range of dissolved oxygen levels observed at one or more suitable reference sites.

Table 5. Tidal Channel Water Quality Performance Goals

Monitoring Year	Performance Goals
Applicable to All Years	Dissolved oxygen levels should remain within healthy levels for fish and other aquatic organisms; levels should not drop below 2 parts per million for extended periods.

4.3.3 Adaptive Management

The main purpose of subtidal and intertidal channel restoration at Ballona is to provide sufficient tidal flow for the development of high-quality tidal wetland habitat. A secondary function is to provide habitat for wildlife species associated with shallow and deepwater habitats. The structure and function of tidal channels at the BWER will be most influenced by the design process, with additional development based on changes in the tidal prism due to sedimentation or erosion. The development of appropriate animal communities within tidal channels is primarily related to habitat structure, sediment characteristics, water quality, and the availability of food sources. Monitoring and performance goals focus on major changes in channel location or morphology, the development of a diverse fish community, and healthy dissolved oxygen levels. It is expected that the desired function of tidal channels should be achieved immediately following the restoration of tidal activity. Most of the changes in tidal channel morphology are expected to occur within the first year or two, with less extensive changes occurring in subsequent years based on rates of erosion and sedimentation, the occurrence of major storm events, and the rate of vegetation establishment along channel margins, among other factors. Similarly, desired water quality levels (as measured by dissolved oxygen levels) are expected to be achieved through the design process, and as such, problems should be evident within the first one to two years following restoration of tidal activity. Fish use of tidal channels is also expected to occur immediately following the restoration of tidal activity, with subsequent changes in abundance and community composition as habitat structure (e.g., channel morphology or establishment of macroalgae) and food availability evolve within the tidal channels.

If subtidal or intertidal channels show a lack of progress toward meeting performance goals for channel morphology, water quality, or fish use within the first two to three years, an assessment of overall trends will be conducted to determine whether adaptive management is warranted. Potential causes of poor performance in terms of channel morphology and water quality are most likely to be related to tidal prism and the associated rates of tidal velocity, circulation, and residence time. In terms of water quality, problems may also be related to contamination issues in Santa Monica Bay or upstream of the Reserve, contamination from stormwater runoff from developed areas surrounding the Reserve, or sediment contamination within the Reserve. Additional studies may be required to identify problems with tidal circulation or potential sources of water or sediment contamination. If it is determined that changes in management are necessary, potential actions include modification of the tidal inlet or channel morphology to alter tidal prism or circulation patterns or remediation efforts to improve sediment or water quality.

If fish populations within the tidal channels fail to meet performance goals within the first two to three years, an assessment of overall trends will be conducted to determine whether the lack of progress in meeting performance goals is specific to the BWER or is related to a regional condition. If it is determined that the lack of progress in meeting performance goals is specific to the BWER, additional studies should be conducted to determine whether the lack of progress is a result of misguided performance goals or due to habitat conditions within the BWER. If new information suggests that performance goals may be deficient, appropriate modifications will be made. However, if there is no evidence to suggest that performance criteria are deficient, studies will be undertaken to determine the cause of the lack of progress in meeting performance goals. Potential causes include problems with tidal channel design which may affect tidal circulation patterns, water quality, or habitat structure. Other problems may be related to contamination issues or poor development of tidal marsh habitat which will affect the availability of food sources for fish. Potential corrective actions include changes to the channel design, modification of tidal regimes where possible (e.g., in the managed tidal portions of Area B), remedial actions to address water or sediment contamination, or modification of vegetation structure or composition.

As with other habitats and monitoring variables, adaptive management triggers for tidal channels are primarily based on significant deviation from the expected trajectory of biotic community development (i.e., significant deviation from the performance goals). However, for fish use of tidal channels, additional triggers may include abnormal declines in fish populations, evidence of a fish die-off, or large increases in non-native fish species.

4.4 Mudflat Habitat

Monitoring for mudflat habitat will focus on the establishment of a diverse macroinvertebrate population and use of mudflat habitat by wading birds. Because the colonization and use of mudflat habitat by wildlife species is subject to a wide range of unpredictable ecological factors, the use of reference sites may be useful for wildlife monitoring parameters. Potential mudflat reference sites include the tidal wetlands at Tijuana Estuary in San Diego County, Upper Newport Bay in Orange County, Mugu Lagoon in Ventura County, or Carpinteria Salt Marsh in Santa Barbara County, among others.

4.4.1 Monitoring

<u>Macroinvertebrate Abundance and Diversity</u>

To reduce the level of effort involved, monitoring for macroinvertebrate colonization will be conducted at the level of order, suborder, or genus (depending on available funding). Monitoring will be designed to capture the overall abundance (or biomass) and order, suborder, or genus diversity of macroinvertebrates greater than 0.1 inche (3 millimeters) in size—although smaller size classes are often used, this greatly increases the level of effort and cost involved in sampling. This can be accomplished through the use of a suitable number of sediment cores from which macroinvertebrates can be sifted, identified to the level of order, sub-order, or genus, and quantified. Quantification may consist of either counts of individuals or measurements of biomass. Monitoring will begin following one full year after the reestablishment of tidal activity and will be conducted annually for the duration of the 10-year monitoring period.

Identification of macroinvertebrates can be a time consuming process (Callaway et al. 2001), and depending on the funding available for monitoring, it may be necessary to investigate alternative monitoring approaches to assess the health of the macroinvertebrate population at the BWER. One potential alternative includes the use of indicator or umbrella species to assess the overall health of the macroinvertebrate population.

Bird Abundance and Diversity

Monitoring of bird use will be conducted in conjunction with bird monitoring in other habitats at the BWER and will be consistent with the methods used elsewhere in the Reserve. Monitoring will be designed to capture the abundance and species richness of birds observed using the mudflat habitat. Unlike bird use in other habitats, it is expected that bird use of mudflat habitat will be limited to foraging, and thus, there is not a need to capture the activities in which the birds were engaged while using mudflat habitat. Due to the large seasonal variation in bird migration and breeding patterns, monitoring for bird use of mudflat habitat will be conducted at intervals throughout the year. Monitoring will be timed to occur during peak periods of bird activity; in the case of mudflat habitat, this would be at low tide. Because the ecological factors involved in bird use of mudflat habitat are based on a complex set of factors extending well beyond the limits of the BWER, this monitoring will be conducted every year during the first ten years of the monitoring period to capture the full range of variability and to compensate for stochastic events which may affect bird use in any given year. As noted above, it may be useful to also monitor bird use of mudflat habitat at suitable reference sites and to assess conditions at the BWER relative to conditions at the reference sites.

4.4.2 Performance Goals

Macroinvertebrate Abundance and Diversity

Given the complex set of factors involved with macroinvertebrate colonization of mudflat habitat, the performance goals presented here are based on a steady increase in macroinvertebrate abundance and taxonomic richness (at the level of order, suborder, or genus). It is expected that colonization of mudflat habitat will occur within the first year following the restoration of tidal activity; however, it may take a number of years for the macroinvertebrate community to reach pre-restoration levels of diversity and abundance. It may take several additional years for macroinvertebrate diversity and abundance to exceed pre-restoration levels.

Table 6. Mudflat Macroinvertebrate Performance Goals

Monitoring Year	Performance Goals*
1 – 3	**A.** Macroinvertebrate order diversity should be near pre-restoration levels within one to two years following restoration of tidal activity. **B.** Macroinvertebrate abundance or biomass (by order) may be significantly lower than pre-restoration levels but should show a steady increase during the first years following restoration of tidal activity.
4 – 7	**A.** Macroinvertebrate order diversity should be at or above pre-restoration levels. **B.** Macroinvertebrate abundance or biomass (by order) should be at or near pre-restoration levels and should show a steady increase.
8 – 10	**A.** Macroinvertebrate order diversity should exceed pre-restoration levels. **B.** Macroinvertebrate abundance or biomass (by order) should exceed pre-restoration levels.

* Based on sampling of macroinvertebrates greater than 0.1 inch (3 millimeters) in size.

Bird Abundance and Diversity

As noted above, the performance goals for bird use of mudflat habitat are based on the abundance and species richness of birds observed using mudflat habitat. Use of mudflat habitat by birds is likely to be closely linked to colonization of the habitat by macroinvertebrates. As such, the performance goals presented here should be considered in relationship to the observed rates of macroinvertebrate colonization.

Table 7. Mudflat Bird Performance Goals

Monitoring Year	Performance Goals
1 – 3	**A.** A variety of wading and other mudflat-associated bird species should be observed foraging in mudflat habitat, although species richness may be lower than observed prior to the restoration. **B.** The abundance of wading and other mudflat-associated bird species should show a steady increase in conjunction with the development of the macroinvertebrate community.

Table 7. Mudflat Bird Performance Goals

Monitoring Year	Performance Goals
4 – 7	**A.** The species richness of wading and other mudflat-associated birds observed foraging in mudflat habitat should be within pre-restoration levels. **B.** The abundance of wading and other mudflat-associated bird species should observed foraging in mudflat habitat should be within pre-restoration levels.
8 – 10	**A.** The species richness of wading and other mudflat-associated birds observed foraging in mudflat habitat should exceed pre-restoration levels. **B.** The abundance of wading and other mudflat-associated bird species should exceed pre-restoration levels.

4.4.3 Adaptive Management

The primary goal of mudflat restoration at the BWER is to provide foraging habitat for wading birds. Monitoring parameters and performance goals are based on the total area of mudflat remaining in an unvegetated state or being colonized by seaweeds and other macroalgae, colonization by macroinvertebrates, and the use of mudflat habitat by wading birds for foraging. The area of mudflat habitat remaining unvegetated or being colonized by seaweeds will primarily be determined by design elevations and should not change significantly over time. It is assumed that bird species will begin using mudflat habitat immediately following restoration of tidal activity, with subsequent changes in abundance and species composition as the mudflat is colonized by macroinvertebrates. Macroinvertebrate colonization is also expected to occur relatively rapidly following restoration of tidal activity. It is expected that trends in bird use of mudflat habitat will be evident within three to five years following restoration of tidal activity and trends in macroinvertebrate colonization should be evident within five years.

If it is determined that bird use or macroinvertebrate colonization of mudflat habitat does not demonstrate a suitable trajectory toward achieving performance goals within the expected timeframe for trends to become apparent, an assessment of overall trends in bird use will be conducted to determine whether trends are specific to the BWER or occur at a regional scale. If it is determined that the lack of progress in meeting performance goals is specific to the BWER, additional studies or corrective actions may be warranted. Potential causes for a lack of progress in meeting performance goals for birds are likely to be related to low rates of macroinvertebrate colonization or the presence of bird predators. Potential corrective actions for improving bird performance include changes aimed at increasing rates of macroinvertebrate colonization or initiation of predator management. Potential causes of poor performance for macroinvertebrates may include incompatible sediment composition, sediment contamination, or excessive foraging by birds during the early stages of colonization. Although modifying sediment composition of the mudflat habitat may not be practicable, remedial actions to reduce sediment contamination and actions to reduce foraging pressure from birds may be possible.

4.5 Brackish Marsh

Brackish marsh habitat is formed in portions of tidal marsh receiving seasonal or perennial input of freshwater (Desmond et al. 2001). These habitats represent a transition zone between freshwater and saline conditions, and as such, are characterized by an overlapping mix of species adapted either freshwater or saline conditions, as well as a suite of species unique to brackish conditions. Given the high variability among brackish marshes, developing detailed performance goals is not practical. As such, the monitoring and performance goals presented below include only basic metrics of habitat performance.

4.5.1 Monitoring

Brackish marshes are highly variable in terms of hydrology, salinity, vegetation, and wildlife use. The brackish marsh should be treated as a transition zone similar to the upland-wetland transition zone in the sense that it may be difficult to determine the boundary between the brackish marsh and the adjacent habitats and to define a target plant community (see note on monitoring for transition zones in Section 4.11). It is expected that the extent of the brackish marsh “transition zone” may fluctuate from season to season and year to year. Although the primary ecological factors responsible for the development of brackish marsh include hydrology and salinity, these two factors are likely too variable both within and among brackish marshes to be of use in the monitoring program. Colonization of brackish marsh habitat by specific plant or wildlife species is also highly variable. Given this high variability, monitoring in brackish marsh habitat will focus primarily on vegetative cover and a lack of highly invasive weeds.

<u>Vegetation and Invasive Plants</u>

Vegetation monitoring will be designed to capture the cover of vegetation and the presence and extent of invasive weeds within areas considered brackish. Because the area of brackish marsh will change from year to year, it will not be possible set quantitative goals for vegetation cover—instead, monitoring in this habitat will focus on a qualitative assessment of vegetation establishment and a lack of highly invasive weeds. Monitoring for establishment of brackish marsh vegetation will be conducted on an annual basis during the entire 10-year monitoring period.

4.5.2 Performance Goals

<u>Vegetation and Invasive Plants</u>

Vegetation performance goals for brackish marsh should be based on a lack of highly invasive weeds and the establishment of vegetative cover. Given that the area of brackish marsh will vary from year to year, it will be difficult to quantify the percent cover of brackish marsh vegetation. As such, performance goals for vegetation in this habitat are qualitative in nature and have been designed to assess the establishment of vegetation or, conversely, the absence of unvegetated areas. Performance goals are also based on low cover of invasive weeds.

Table 8. Brackish Marsh Vegetation and Invasive Plant Performance Goals

Monitoring Year	Performance Goals
1 – 3	**A.** Canopy cover may be low, but vegetation should show signs of establishment and spread. **B.** Cover of invasive species listed as "High" or "Moderate" by the Cal-IPC, exclusive of annual grasses, should remain low.
4 – 7	**A.** Canopy cover should be relatively high, approaching 75% or greater by the end of Year 7, and should show signs of significant natural recruitment. **B.** Cover of invasive species listed as "High" or "Moderate" by the Cal-IPC, exclusive of annual grasses, should remain low.
8 – 10	**A.** Canopy cover should be nearly complete. **B.** Cover of invasive species listed as "High" or "Moderate" by the Cal-IPC, exclusive of annual grasses, should remain low.

4.5.3 Adaptive Management

The primary ecological factors involved in the development of brackish marsh habitat are related to hydrology and the relative proportions of fresh and saline water entering the system (Desmond et al. 2001). Because brackish marsh represents a fluctuating transition zone between fresh and saline environments, it is difficult to define a target biological community for this habitat. As such, performance goals are aimed at general factors such as the development of vegetative cover and the occurrence of invasive plants. As with tidal marsh habitat, it is expected that trends in the development of vegetation should be apparent within three to five years following the restoration of tidal activity.

If brackish marsh vegetation does not demonstrate a satisfactory trend toward meeting performance goals within the first three to five years, an assessment of the causes will be undertaken. Potential causes of poor vegetation establishment are likely to be related to physical or chemical properties of the sediment, including sediment contamination, or deficiencies in the tidal regime. Potential corrective management actions may include additional planting or seeding, the addition of supplementary irrigation or slow-release fertilizers, or remedial actions to reduce sediment contamination or to improve other aspects of sediment quality.

4.6 Salt Panne

Salt pannes are characterized by irregular or seasonal water fluxes—including from both freshwater inputs such as rainfall or groundwater and saline inputs such as tidal inundation during extreme high tides—followed by prolonged dry-down periods which concentrate salts in the soil surface horizons at levels of up to 200 parts per thousand (Vivian-Smith 2001). The resulting habitat is a salt-crusted depression largely devoid of vegetation in the center and often fringed by halophytic plant species along the margins (Sharitz and Pennings 2006). Existing salt panne habitat at the BWER is valued primarily for its use by birds. Created salt panne habitat will also have the potential to host rare species of tiger beetles such as the western mudflat tiger beetle (*Cicindela trifasciata sigmoidea*) which has been previously documented from Area B (PWA et al. 2006).

Performance goals for restored salt panne habitat focus on (1) the primary ecological drivers of salt panne habitat development: hydrology and salinity, (2) the characteristic expression of these ecological drivers: lack of vegetation, and (3) the primary value of salt panne habitat: use by birds for foraging. In terms of bird use, performance goals do not focus on specific species or other taxonomic groups, but instead focus on bird guilds or other broad functional groups of birds such as shorebirds or wading birds. Monitoring for these parameters is relatively simple and can be easily repeated over long time periods and by a variety of individuals or organizations, including volunteers.

As noted in the salt panne habitat description in Section 3.2.3 of this report, two types of salt panne habitat currently occur at the BWER, those fed by irregular tidal inundation by extreme high tides and those fed by shallow groundwater or stormwater runoff. Salt panne creation at the BWER is focused on the former type; however, there is potential for the latter type to develop in areas designed as seasonal wetland habitat. The monitoring and performance goals presented here are aimed at the salt panne habitat designed to receive irregular inundation by extreme high tides. However, it should be recognized that salt panne habitat that unexpectedly forms in areas originally designed as seasonal wetland habitat or in other portions of the Reserve may provide valuable wildlife habitat and should be considered an asset to the overall restoration, not a failure in the creation of seasonal wetlands.

4.6.1 Monitoring

Monitoring for restored salt panne habitat will focus on (1) hydroperiod and salinity, (2) vegetative cover (or lack thereof), and (3) habitat use by guilds or other functional groups of birds. Monitoring will commence after the first full growing season following the completion of construction and will occur for a period of at least 10 years. As noted previously, salt panne habitat may develop in areas not explicitly designed as salt panne habitat—if this occurs, salt panne monitoring should be expanded to include these areas. Because our knowledge of salt panne development is limited, it may be useful to monitor for hydrology, salinity, and bird use at both the BWER and at one or more reference sites containing functioning salt panne habitat such as at Upper Newport Bay in Orange County or Peñasquitos Lagoon in San Diego County. Other potential salt panne reference sites include Point Mugu in Ventura County or the San Dieguito and Poseidon wetlands in San Diego County; however, these sites contain constructed salt panne habitat, and it is unclear whether these salt pannes function similar to naturally occurring salt pannes in the region. During the initial phases of the restoration in Area A, monitoring for these parameters may also be conducted in the existing salt panne habitat in Area B. Monitoring both at reference sites and in existing salt panne habitat at the BWER may provide a better understanding of how salt panne habitat functions within the region as well as useful data to guide adaptive management decisions.

<u>Hydrology and Salinity</u>

The goal of hydrology and salinity monitoring is to determine whether created salt panne habitat receives the frequency and duration of tidal inundation necessary to reach hypersaline conditions. Monitoring for hydrology can be done relatively inexpensively using water level data loggers (however, if salt panne habitat is constructed using a clay layer to reduce percolation, care should be taken not to penetrate the clay layer and cause drainage). Use of such equipment can provide continuous, high-precision monitoring and allows for an understanding of hydrological patterns at multiple time scales. Alternatively, this monitoring can be accomplished by monthly (or more frequent) monitoring using staff gauges or other manual methods. In addition to providing fine-scale data, the use of data logging equipment would require fewer visits to salt panne habitat and reduced disturbance in this habitat. However, there may be security issues involved in leaving scientific equipment at the site. The use of staff gauges would require less up-front cost in terms of equipment and reduced potential for equipment loss or damage; however, this method would require more visits and disturbance to the site and would provide only limited insight into seasonal patterns of inundation frequency and duration. That said, the expense involved in monitoring staff gauges may be reduced by employing volunteers for this task. If staff gauges are used, monitoring should occur following extreme tides and heavy rainfall events and at appropriate intervals thereafter to determine the duration of inundation following such events. The appropriate interval for monitoring following such events will depend on the size of the event (i.e., height of the tide or amount of rainfall) and the rates of percolation, evaporation, and transpiration (assuming the presence of vegetation) unique to each panne. As such, the most appropriate interval for hydrology monitoring should be based on observations of the depth and duration of inundation made during the first year following the restoration of tidal activity.

Soil salinity can be measured by taking soil cores from within the potential plant rooting zone (to a depth of approximately 4 to 6 inches [10 to 15 centimeters]) along a transect from the edge of the salt panne to the lowest point in the center of the salt panne. Collecting soil cores along an elevation gradient from the edge of the salt panne to the center will provide a detailed understanding of salinity patterns as they relate to inundation depths as inferred by elevation within the salt panne (i.e., lower elevations are assumed to have greater depth and duration of inundation). Soil cores can be either analyzed in-house or sent to a soil testing laboratory for analysis using standard protocols for determining soil salinity. Soils cores should be analyzed for salinity in 1- to 2-centimeter intervals as salinity levels can vary dramatically within the soil profile and will differentially affect plants based on their salt-tolerance and rooting depth.

To avoid excessive disturbance in these sensitive habitats, monitoring for soil salinity will be conducted once annually, when the pannes are dry. This will be done toward the end of the dry season, when salt concentrations are expected to be at their highest (Pratolongo et al. 2009). However, if salt panne soil salinity is to be compared to salinity levels from reference salt pannes, sampling should occur at the same time of year to ensure that results are comparable. Using randomly positioned transects may help reduce impacts associated with sampling along a permanent transect year after year. Given the potential for large variations in soil salinity due to rainfall levels, it may be useful to monitor precipitation at both the BWER and one or more reference sites and to incorporate rainfall into the analysis of soil salinity. Comparing rainfall levels between both years and sites will allow for an analysis of salinity levels weighted by rainfall which may be a better indicator of habitat function than salinity levels alone.

Modifications to this monitoring scheme may be necessary if salt panne habitat is not developing as expected. For instance, if weeds or other unwanted vegetation become established within the salt pannes, it may be necessary to monitor salinity levels during the growing season (as opposed to the peak of the dry season) to determine what conditions are like when the plants are germinating or actively growing.

Vegetation and Invasive Species

The goal of vegetation monitoring in created salt panne habitat is to (1) determine whether vegetation within the salt panne habitat is expanding, receding, or remaining stable and (2) identify the presence of invasive plant species that may require control.

Monitoring of vegetative cover within salt panne habitat can be combined with vegetation monitoring in other habitats at Ballona and is easily accomplished through GIS analysis of vegetation data collected on the ground. Such monitoring would consist of delineating the area of unvegetated salt panne habitat using a handheld GPS device with sub-meter accuracy and subsequent GIS analysis to calculate the total area of unvegetated salt panne habitat relative to the as-built area of the salt panne habitat. During this vegetation monitoring, the plant species present along the fringes or within the salt panne habitat will be documented and the presence of non-native weeds will be noted. Although species composition and the presence of non-native weeds will not be monitored quantitatively, an understanding of which plant species are encroaching on or establishing within the salt panne habitat will help inform management of these areas. Monitoring of vegetative cover may also be accomplished through GIS analysis of aerial imagery; however, this method would still require on-the-ground monitoring to determine the species composition of any developing vegetation. This on-the-ground monitoring could be combined with hydrology monitoring or annual soil salinity monitoring. The methods chosen for determining the total cover of vegetation will be consistent with the methods used for determining vegetative cover in other habitats within the Reserve.

Monitoring for vegetative cover and the composition of encroaching vegetation will commence following the first full growing season after construction has been completed and will occur in mid- to late summer, after plant growth has slowed but when plants are still identifiable. If aerial imagery is used to determine the total cover of vegetation, the images should be taken during the mid- to late summer for the same reason. Vegetation monitoring will be conducted annually for the first five years following the restoration of tidal activity and thereafter at Year 7 and Year 10, assuming vegetation is on track to meet final performance goals.

Bird Abundance and Diversity

The goal of bird monitoring is to determine whether salt panne habitat will support a diversity of bird species. However, a distinction should be made between the *ability* of created salt panne habitat to support desired levels of bird use and the *actual use* of salt panne habitat by such species. Patterned use of the existing salt panne habitat in Area

B may limit bird use of created salt panne habitat in Area A without being indicative of the suitability of the created salt panne habitat to support birds. This is a particularly important point to consider given that the salt panne habitat planned for Area A consists of many small, scattered salt pannes whereas the existing salt panne habitat in Area B consists of one large, contiguous area. Because of the greater area and reduced perimeter to area ratio of salt panne habitat in Area B, birds may favor this habitat over the smaller areas of salt panne habitat to be created in Area A. If bird use of the created salt panne habitat in Area A is determined to be inadequate, it may be necessary to monitor invertebrate populations or other indicators of the habitat's *ability* to support the desired diversity and abundance of birds.

Monitoring for bird use of salt panne habitat can be conducted in conjunction with bird monitoring in other habitats at the BWER and will be consistent with the methods used for bird monitoring in other habitats throughout the Reserve. Monitoring will be designed to capture (1) the abundance and diversity of bird species observed using the salt panne habitat and (2) the activities in which the birds were engaged within the salt panne habitat (i.e., foraging, resting, etc.).

Due to the large seasonal variation in bird migration and breeding patterns, monitoring for bird use of salt panne habitat will be conducted at intervals throughout the year, with reduced monitoring during the summer breeding period to limit disturbance to breeding birds. Monitoring will be timed to occur during peak periods of bird activity and should occur when the salt panne habitat is inundated or when invertebrates are active at the surface of the salt pannes, as these are the times when birds are most likely to use salt panne habitat for foraging. Because the ecological factors involved in bird use of salt panne habitat are based on a complex set of factors extending well beyond the limits of the BWER, this monitoring will be conducted every year during the first ten years of the monitoring period to capture the full range of variability and to compensate for stochastic events which may affect bird use in any given year.

4.6.2 Performance Goals

As noted above, performance goals for created salt panne habitat are based on (1) hydrology, (2) soil salinity, (3) lack of vegetative cover and invasive weeds, and (4) bird use. The first three parameters are relatively easy to measure and are potentially subject to manipulation, whereas the fourth parameter is less easily measured and may not be subject to manipulation. As such, the first three parameters should be the primary factors used to determine successful development of the created salt panne habitat. As noted above, bird use of salt panne habitat is not well understood and may not be within the control of the BWER land manager. As such, creating strict performance goals for bird use of created salt panne habitat at BWER is not recommended. Bird use of salt panne habitat should be used to determine the general quality of the salt panne habitat created (e.g., high bird use would indicate high habitat quality and vice versa). If it is determined that the salt panne habitat created is of low habitat quality for birds, additional studies and adaptive management actions may be appropriate.

Hydrology and Salinity

Hydrology performance goals for salt panne habitat are be based on the frequency of inundation and the duration of subsequent ponding which should occur at sufficient frequency and duration to create hypersaline conditions within the salt panne habitat. Because hydrologic conditions are not expected to change substantially over time in the same way vegetation communities might develop, the hydrology performance goals presented in Table 10 are the same for each year of the 10-year monitoring period. Because salt panne habitat will receive some proportion of its hydrologic input from rainfall, the assessment of hydrology performance goals should take into account annual and seasonal variation in rainfall levels.

Performance goals for soil salinity should be based on the levels required to preclude vegetation. The goals presented below assume that salt panne habitat will be created using saline soils or by the addition of salt, and that salinity levels will be high from the outset. If non-saline soils are used and/or salt is not added, performance goals will require modification based on the expected rate of habitat development. Ultimately, the desired outcome is for salinity levels to be within the range of levels found within the rooting zone (top 15 centimeters of the soil profile) in functioning salt panne habitat in Area B or from salt panne habitat at one or more reference sites.

Table 9. Salt Panne Hydrology and Salinity Performance Goals

Monitoring Year	Performance Goals
Applicable to All Years	**A.** The frequency of inundation and duration of ponding should be within the range documented from salt panne habitat in Area B or from one or more reference sites. **B.** Soil salinity levels in created salt panne habitat should be on a trajectory toward levels observed in salt panne habitat in Area B or from one or more reference sites.

Vegetation and Invasive Species

Performance goals for vegetation cover should be based on a steady trend toward attaining non-vegetated, periodically-ponded areas due to hypersaline conditions. It is expected that some vegetation may become established along the fringes and within the salt panne habitat during the initial phases of the salt panne development when salinities are lower. It is expected that establishment of new plants will be deterred as salinities rise; however, plants that become established during the early years of salt panne development and that are able to tap into deeper, less saline groundwater, may be able to resist increasing salinity levels at the soil surface and may require physical removal. Given these expected trends, performance goals should be based on a sustained decline in vegetative cover and the assumption that some level of active vegetation management may be necessary, especially during the early years of salt panne development when salinities are lower. The ultimate performance goal should be based on a sustained lack of vegetation in a majority of the area originally designed as salt panne habitat. However, this number should also take into account the development of salt panne habitat in areas not originally designed as salt panne habitat; this will account for salt panne habitat that is lost to sea level rise and a corresponding increase in salt panne habitat resulting from the conversion of seasonal wetland habitat in the transition zones, also due to sea level rise.

In addition to the vegetation cover performance goals, invasive weeds designated by the Cal-IPC (2013) as “High” or “Moderate” (exclusive of annual grass species) should remain at low levels. This performance goal is exclusive of non-native annual grass species which are difficult to control and are a dominant member of most herbaceous vegetation communities in California.

Table 10. Salt Panne Vegetation and Invasive Plant Performance Goals

Monitoring Year	Performance Goals
1 – 5	**A.** A majority of the area originally designed as salt panne habitat should remain unvegetated. Plants that establish during the early years may require physical removal; however, new plants should be prevented from becoming established as salinities rise. **B.** Cover of invasive weeds rated as “High” or “Moderate” by the Cal-IPC, exclusive of annual grass species, should remain low.
6 – 10	**A.** A majority of the area originally designed as salt panne habitat should remain unvegetated. Plants that became established during the early years should no longer be present within the salt panne habitat, and new plants should not become established. **B.** Cover of invasive weeds rated as “High” or “Moderate” by the Cal-IPC, exclusive of annual grass species, should remain low.

Bird Abundance and Diversity

Performance goals for bird use of created salt panne habitat are be based on the abundance and species richness of birds observed using salt panne habitat. It may be useful to base the assessment on conditions relative to suitable reference salt pannes. Bird use of specific habitats is dependent on a wide range of variables, including patterned use of existing habitat and the area to perimeter ratio of certain habitats. As such, the performance goals presented here should be used to evaluate the general quality of created salt panne habitat and to inform the need for corrective management actions to improve habitat quality for birds. As noted in Section 4.6.1, patterned use of salt panne habitat in Area B, as well as the larger area of salt panne habitat in Area B, may limit bird use of smaller salt pannes to be constructed in Area A—this may not necessarily reflect the *ability* of constructed salt panne habitat to support high levels of bird use. If bird use of created salt panne habitat is low, it may be appropriate to develop performance goals based on the *ability* of the habitat to support birds as measured using invertebrate levels or another appropriate surrogate of habitat quality.

Table 11. Salt Panne Bird Performance Goals

Monitoring Year	Performance Goals
1 – 3	A variety of bird species should be observed foraging in the salt panne habitat, although the diversity and abundance of birds may be lower than observed prior to the restoration.
4 – 7	Species richness and abundance of birds observed using salt panne habitat should each be within pre-restoration levels and should be increasing with each successive year.
8 – 10	Species richness and abundance of birds observed using salt panne habitat should each be greater than pre-restoration levels; however, annual increases may slow relative to increases observed in Years 4-7.

4.6.3 Adaptive Management

The primary ecological factor involved in the development of salt panne habitat is hydrology, including the frequency and duration of inundation and the salinity of inundating waters. The primary goal of salt panne restoration at Ballona is to provide high quality foraging and/or resting habitat for bird species associated with salt panne habitat. Performance goals for salt panne habitat are based on aspects of hydrology, soil salinity, vegetation composition and cover, and use by birds for foraging. It is expected that trends in salt panne development may take five or more years to become apparent. Because bird use of salt panne habitat is expected to evolve in conjunction with the development of this habitat, it may take a similar amount of time for trends in bird use to become apparent.

Potential corrective management actions related to the development of salt panne habitat include addition of salt to rapidly increase salinity levels, modifications to salt panne hydrology (through adjustments in grading) to alter inundation frequency and duration, and management of vegetation in the early years of habitat development when salinity levels are low. Other potential management actions may be possible depending on the cause of poor performance. The assessment of salt panne performance should take into consideration the potential for habitat conversion to tidal marsh as a result of sea level rise. This transition is likely to occur over a period of several decades or more. The potential for wetland type conversion due to sea level rise combined with a general lack of knowledge regarding salt panne development makes the monitoring of this habitat type the most nebulous of all of the habitats at the BWER. As such, great care and consideration should be given to any potential management actions related to this habitat.

If the frequency and duration of tidal inundation in the restored salt panne habitat is not sufficient to create hypersaline conditions (i.e., within the range of the same parameters in Area B or at reference sites), an evaluation of habitat development trends will be conducted prior to any modifications related to hydrology. If performance goals for salinity levels and vegetation are being achieved, modifications to salt panne hydrology may not be necessary. However, if the salt pannes demonstrate a lack of progress in meeting performance goals for salinity levels and vegetation, modification of salt panne hydrology may be warranted. In this case, salt panne topography should be assessed in relationship to tidal inundation and appropriate modifications should be made. Because modifications to salt panne hydrology could require the use of heavy equipment which has the potential to cause significant disturbance to other habitats, such management actions will not be undertaken without significant consideration.

If trends in salinity levels are not within the appropriate range identified in the performance goals, an evaluation of trends in salinity levels will be conducted prior to taking any management actions. If salinity levels are sufficiently high to exclude the establishment of vegetation, no management actions may be necessary—instead, adjustments to the performance goals may be warranted based on new information which improves our understanding of salt panne development. If, however, salinity levels are low and do not exclude vegetation, options for increasing salinity will be investigated. The most likely management actions would be to add salt to the salt panne soils or to modify salt panne hydrology through changes in topography.

In the event that trends in vegetation development (or lack thereof) do not demonstrate suitable progress toward meeting performance goals, an evaluation of vegetation trends will be conducted prior to implementing any management actions. If vegetative cover remains low, no management actions may be necessary—instead, adjustments to the performance goals may be warranted based on new information which improves our understanding of salt panne habitat development. However, if it is determined that vegetation within the salt panne habitat is not on a suitable trajectory to meet the goals of the salt panne restoration, the causes of this poor performance will be investigated. These investigations should focus primarily on seasonal and annual variations in hydrology and salinity. Once the cause of poor vegetation performance is identified, appropriate management actions will be developed. If hydrology and salinity are determined to be on appropriate trajectories for salt panne development, vegetation management in the form of hand removal may be the most appropriate management action. If, however, hydrology and salinity are determined to not be on target, modifications related to these parameters may be the most appropriate management action.

If bird use of salt panne habitat does not demonstrate suitable progress toward meeting performance goals, a thorough analysis of the causes of this poor performance will be conducted prior to implementing any corrective management actions. If it is determined that salt panne hydrology, salinity, and vegetation are all within an acceptable range (e.g., within the range of the same variables in other functioning salt panne habitat), additional factors will be analyzed. Potential factors to be analyzed include those related to food sources (e.g., invertebrate populations), predation by cats and other urban predators, or competition from other birds, particularly aggressive non-native birds. Once the potential cause of poor bird performance is determined, appropriate corrective management actions will be developed.

4.7 Seasonal Wetlands

Within the context of the larger tidal wetland restoration at the BWER, the goal of including seasonal wetlands is to increase the diversity of non-tidal wetland habitat available for wildlife use. The primary ecological driver of seasonal wetland development is hydrology, and this will be the focus of monitoring and performance criteria for this habitat type. Additionally, seasonal wetlands will be monitored for the presence of invasive weeds.

4.7.1 Monitoring

Hydrology

Monitoring will be conducted to determine the presence of wetland hydrology. Hydrological monitoring can be accomplished through visual observations of inundation made on a weekly basis during the rainy season. Monitoring will be designed to capture the number of pools inundated, the approximate percentage of area inundated within each pool, and the duration of inundation. As pools dry down, the duration of soil saturation will also be documented. Hydrological monitoring will occur on an annual basis for the full 10-year monitoring period to account for natural variation in rainfall levels and other factors affecting seasonal wetland hydrology.

Vegetation and Invasive Plants

Monitoring will be conducted to determine the presence and extent of invasive weeds listed by the Cal-IPC (2013) as "High" or "Moderate", exclusive of non-native annual grasses. This should consist of visual observations of invasive weeds and an estimate of total cover within the seasonal wetlands. Monitoring for invasive weeds will be conducted twice per year (or more frequently) during the entire 10-year monitoring period, once near the beginning of the growing season and during the annual vegetation monitoring toward the end of the growing season (or more frequently). Because it will not be possible to eliminate all propagule sources for non-native weeds which occur outside of the BWER, some level of monitoring for invasive weeds will be required for the lifespan of the restoration.

4.7.2 Performance Goals

Hydrology

Hydrology performance goals for seasonal wetlands are be based on the number of pools inundated during each rainy season and the length of inundation or soil saturation. However, because seasonal wetland hydrology will be driven by rainfall, performance goals will be linked with annual rainfall levels. Thus, the performance goals presented here will generally be applied only to years of normal or greater rainfall as determined by the use of local rainfall data and Natural Resources Conservation Service ("NRCS") WETS tables (NRCS 1997; Sprecher and Warne 2000). Due to this variation in annual rainfall levels, it is likely that not all pools will fill every year, and the ultimate goal should be to have prolonged (i.e., two consecutive weeks or longer) inundation in a majority of all seasonal wetlands—with the remaining seasonal wetlands containing saturated soils for at least two consecutive weeks—in any given year.

Table 12. Seasonal Wetland Hydrology Performance Goals

Monitoring Year	Performance Goals
Applicable to All Years	During years of normal rainfall, the majority of seasonal wetlands should be inundated for at least two consecutive weeks during the rainy season; these should generally be the same pools each year. The remaining seasonal wetlands should contain saturated soils for at least two consecutive weeks during the rainy season; these should generally be the same pools each year.

Vegetation and Invasive Plants

The performance goals presented here focus on the cover of invasive species, exclusive of non-native annual grasses, and the presence of wetland-adapted species (both native and non-native). It is expected that seasonal wetland habitats will contain a high percentage of non-native herbaceous species and, given the ample supply of weed seed sources in the surrounding areas, it is unlikely that these species will ever be fully eradicated. As such, the performance goals are be aimed at depleting the available seed bank, reducing cover of invasive weeds to a minimal level, and encouraging establishment of wetland-adapted species.

Table 13. Seasonal Wetland Vegetation and Invasive Plant Performance Goals

Monitoring Year	Performance Goals
Applicable to All Years	A. Cover of invasive species listed as “High” or “Moderate” by the Cal-IPC, exclusive of annual grasses, should remain low. B. The majority of plant cover, both native and non-native, should be composed of wetland-adapted species listed as facultative (“FAC”) or wetter on the National Wetland Plant List (Lichvar 2012).

4.7.3 Adaptive Management

The goal of seasonal wetland habitat restoration at Ballona is to increase the diversity of non-tidal wetland habitat available for wildlife use. Monitoring parameters and performance goals focus on wetland hydrology and a lack of highly invasive plant species. If it is determined that performance goals are not being met, overall trends in habitat development will be examined to determine whether corrective management actions are warranted. If trends are on track to meet long-term performance goals, no corrective management actions may be warranted and modification of the interim performance goals based on an improved understanding of seasonal wetland habitat development may be the most appropriate course of action. However, if it is determined that corrective management actions are appropriate, these may include alterations to hydrology through grading or modification of substrate characteristics (e.g., soil texture or compaction rates), more intensive weed management, or planting of appropriate native species.

4.8 Riparian Scrub and Woodland

Limited areas of riparian habitat currently exist at the BWER, and riparian habitat restoration is not a primary focus of the overall restoration effort. Some areas of existing riparian habitat will be preserved, such as the eucalyptus grove in the southern portion of Area B; however, a portion of existing low-quality riparian habitat may be converted to other habitat types. Riparian habitat restoration, monitoring parameters, performance goals, and management will focus primarily on sustaining high cover of riparian-associated species and low cover of highly invasive plant species. The goal of preserving the eucalyptus grove is to maintain the trees as viable roosting habitat for monarch butterfly and to prevent the spread of eucalyptus to other portions of the BWER. Long-term management of the eucalyptus grove will focus on eventually replacing the trees with native species suitable for monarch roosting.

In general, high diversity of riparian-associated plant species is the desired outcome of riparian habitat restoration; however, it is expected that establishing a diverse understory within the eucalyptus grove will be exceedingly difficult give the large amounts of litter deposited by these trees as well as allelopathic compounds potentially exuded into the soil. In addition, some native riparian species such as arroyo willow (*Salix lasiolepis*) tend to form dense, monotypic thickets, and although these areas may be low in plant diversity, they provide valuable habitat for riparian-associated wildlife species. Given the difficulty of maintaining a diverse understory in the eucalyptus grove and the tendency of riparian vegetation (i.e., willows) to form dense, monotypic stands, no specific performance goals for native plant composition, other than for invasive weeds, are included here. Instead, performance goals focus on attaining high levels of plant cover and low levels of invasive species (excluding the eucalyptus).

4.8.1 Monitoring

Monitoring of riparian habitats will focus on total canopy cover and composition, including the presence of invasive plant species listed as “High” or “Moderate” by the Cal-IPC (2013), exclusive of eucalyptus trees and non-native annual grasses. This monitoring will be quantitative in nature, with estimates of total cover by species and canopy layer. In addition, the location and extent of invasive weed populations will be documented. Monitoring for vegetation cover and composition will occur annually for the entire 10-year monitoring period. As with other habitats, it may be useful to monitor for invasive weeds twice annually (or more frequently), once near the beginning of the growing season and again during the annual vegetation monitoring to be conducted in mid- to late summer (or more frequently). In addition to the vegetation monitoring, the eucalyptus grove will be assessed for tree health by a qualified arborist every two to three years. These assessments will consist of general observations of tree health and recommendations for management actions, with the ultimate goal of replacing the trees with suitable native species. In addition, the overwintering monarch population will be quantitatively monitored on an annual basis to provide an estimate of the size of the overwintering population.

4.8.2 Performance Goals

Performance goals for riparian habitat restoration focus on maintaining the eucalyptus grove in healthy condition, providing viable roosting habitat for the overwintering monarch population, and maintaining high cover of riparian-associated species (outside of the eucalyptus grove) and low cover of invasive species listed as “High” or “Moderate” by the Cal-IPC (2013), exclusive of eucalyptus and non-native annual grasses.

Table 14. Riparian Vegetation and Invasive Plant Performance Goals

Monitoring Year	Performance Goals
1 – 3	**A.** Canopy cover of riparian-associated species (outside of areas occupied by eucalyptus trees) may be low, but vegetation should show signs of establishment and spread. Areas not occupied by eucalyptus trees should show signs of natural vegetation recruitment or should be planted with appropriate native species. **B.** Cover of invasive species listed as “High” or “Moderate” by the Cal-IPC, exclusive of the eucalyptus trees and non-native annual grasses, should remain low. Eucalyptus trees should not be allowed to expand beyond the baseline population size.

Table 14. Riparian Vegetation and Invasive Plant Performance Goals

Monitoring Year	Performance Goals
4 – 7	**A.** Canopy cover of riparian-associated species (outside of areas occupied by eucalyptus trees) should be relatively high, approaching 75% or greater by the end of Year 7 and should show signs of establishment and spread. **B.** Cover of invasive species listed as "High" or "Moderate" by the Cal-IPC, exclusive of the eucalyptus trees and non-native annual grasses, should remain low. Eucalyptus trees should not be allowed to expand beyond the baseline population size.
8 – 10	**A.** Canopy cover of riparian-associated species (outside of areas occupied by eucalyptus trees) should be nearly complete. **B.** Cover of invasive species listed as "High" or "Moderate" by the Cal-IPC, exclusive of the eucalyptus trees and non-native annual grasses, should remain low. Eucalyptus trees should not be allowed to expand beyond the baseline population size.

4.8.3 Adaptive Management

The goal of riparian habitat restoration at the BWER is to preserve existing riparian vegetation where possible, including maintaining and eventually replacing the eucalyptus grove in Area B, encouraging establishment and expansion of native riparian species, and maintaining low cover of invasive species in these areas. It is unclear at this point what restoration activities will occur in or adjacent to areas currently identified as riparian habitat; however, it is assumed that these restoration activities will be focused on planting or natural recruitment of appropriate riparian-associated native species and removal of any highly invasive species. It is expected that trends in vegetation establishment will be apparent within two to three years following the completion of initial restoration activities.

Management for riparian habitat will focus on attaining near complete cover of riparian-associated species and low levels of invasive species. In addition, the eucalyptus grove will be managed as needed to maintain the overwintering monarch population at existing or improved levels, but to prevent the spread of eucalyptus beyond its current extent and to eventually replace the eucalyptus with appropriate native species. In areas not occupied by eucalyptus trees, canopy cover will ideally consist of a combination of herbaceous plants, shrubs, and small trees. However, as noted above, some native riparian-associated species such as arroyo willow tend to form dense, monotypic stands with little to no understory vegetation—such stands provide valuable habitat for wildlife and are desirable despite having low plant diversity. In addition, it is expected that establishing understory vegetation in areas occupied by eucalyptus will be exceedingly difficult given the large amount of leaf litter, bark, and other debris dropped by these species—as such, no goals have been established for understory vegetation cover in these areas, and management should be focused on establishing native trees to replace the eucalyptus and preventing the spread of the eucalyptus and the establishment of other aggressive invaders.

Potential causes of poor vegetation establishment in areas not occupied by eucalyptus are likely to be related to water availability and physical and chemical properties of the soil. If it is determined that vegetation establishment does not demonstrate suitable progress toward meeting performance goals, studies will be conducted to determine the cause of the poor performance. Potential management actions include additional plantings, addition of temporary irrigation (if not already present), addition of slow-release fertilizers, or the addition of other soil amendments to alter soil physical or chemical properties. If it is determined that soil salinity is a cause of poor vegetation establishment, it may be necessary to modify the planting palette to include more salt-tolerant species.

As noted previously, the eucalyptus grove in Area B is being kept as roosting habitat for monarch butterflies. Although eucalyptus trees are tolerant of a wide range of soil and moisture conditions, there is potential for restoration activities to affect the growth of these trees, and it may be necessary to actively manage the trees to maintain the grove as viable roosting habitat for the monarchs. Any management will be conducted under the advisement of a certified arborist or a monarch expert, as appropriate. Large reductions in the size of the overwintering monarch population will be assessed against historical data from the site and observations of other regional (or wider-scale) trends in monarch population size to determine whether the drop in numbers is specific to the BWER or attributable to regional climate or other wide-scale factors. If the trends appear to be specific to the BWER, a monarch expert will be consulted to determine the potential causes and most appropriate management actions. Long-term management of the eucalyptus grove will focus on replacement of the trees with native trees suitable for monarch roosting.

4.9 Dune

Existing dune habitat at the BWER is composed of relict, stabilized dunes. Despite lacking many of the natural processes present in active dune systems, the dunes at the Reserve provide valuable habitat for a number of sensitive plant and wildlife species and are of great public interest. The goal of dune restoration at the BWER is to mimic conditions within the more stabilized (i.e., backdune) portions of a dune system such as the one at Ormond Beach in Ventura County. Given their removal from the active dune forming processes that occur in foredune habitat, conditions within the more stabilized portions of the dunes at Ormond Beach represent the range of conditions most likely to be achieved at the BWER. Performance goals are be based on the diversity of native dune-associated plant species present (see the potential planting palette included as Appendix A for a list of native plant species typically associated with dunes), total area of vegetation cover, and the absence of highly invasive species. Management actions will focus on maintaining the desired plant community cover and composition, reducing existing levels of invasive weeds, and preventing the establishment of new populations of invasive weeds. Currently, it is unclear whether new dune habitat will be created in addition to the existing dune habitat in the western portion of Area B and the southwestern portion of Area C. If new dune habitat is created, it may be necessary to create a revised set of monitoring protocols and performance goals to account for the different stages of development between the existing and created dune habitat.

4.9.1 Monitoring

Vegetation and Invasive Plants

The composition and cover of vegetation is the dominant characteristic feature of stabilized dune systems and will be the primary focus of monitoring. Monitoring will focus on measurements of plant species richness and cover and on the presence and extent of invasive plant species. General vegetation monitoring for dune habitat will be conducted on an annual basis during entire 10-year monitoring period. Monitoring will be conducted toward the end of the growing season after perennial plants have put on most of their annual growth. As with other habitats, it may be useful to monitor for invasive weeds twice annually (or more frequently), once near the beginning of the growing season and again during the annual vegetation monitoring to be conducted in mid- to late summer (or more frequently). Monitoring will be quantitative and will be conducted using a random sampling strategy or fixed transects. The monitoring scheme to be implemented will be similar to the vegetation monitoring conducted elsewhere in the Reserve. Monitoring will be designed to quantify (1) species richness, (2) vegetative cover, and (3) the presence and extent of invasive weeds. In conjunction with general quantitative vegetation monitoring, the entire extent of dune habitat will be qualitatively surveyed and the location and extent of invasive species rated as “High” or “Moderate” by the Cal-IPC, exclusive of annual grasses, will be documented on maps or aerial imagery. These data will be used to prioritize weed control efforts.

4.9.2 Performance Goals

Performance goals for dune habitat will be based on the diversity of native dune-associated plant species, the total area of vegetation cover, and the cover of invasive species. As noted above, if new dune habitat is to be created, it may be necessary to create a separate set of performance goals for the newly created dune habitat to account for differences in seral stages between created and existing dune habitat. Performance goals for any new dune habitat should be based on developing plant community composition and cover similar to that of the backdune habitat at Ormond Beach or another suitable reference dune system and on maintaining low cover of invasive species.

Table 15. Dune Vegetation and Invasive Plant Performance Goals

Monitoring Year	Performance Goals*
1 – 3	**A.** Total plant cover should be similar to that of other stabilized dunes in the region. Some portion of the dunes should remain unvegetated. **B.** The diversity of native dune-associated plant species should be similar to that of other stabilized dunes in the region. **C.** Existing populations of invasive species listed as "High" or "Moderate" by the Cal-IPC, exclusive of non-native annual grasses, should be significantly reduced during the early years of the restoration. Newly developed populations should not be allowed to become established.
4 – 7	**A.** Total plant cover should be similar to that of other stabilized dunes in the region. Some portion of the dunes should remain unvegetated. **B.** The diversity of native dune-associated plant species should be the same as or greater than that of other stabilized dunes in the region. **C.** Existing populations of invasive species listed as "High" or "Moderate" by the Cal-IPC, exclusive of non-native annual grasses, should be reduced to and maintained at minimal levels. Newly developed populations should not be allowed to become established.
8 – 10	**A.** Total plant cover should be similar to that of other stabilized dunes in the region. **B.** The diversity of native dune-associated plant species should exceed that of other stabilized dunes in the region. **C.** All populations of invasive species listed as "High" or "Moderate" by the Cal-IPC, exclusive of non-native annual grasses, should be reduced to and maintained at minimal levels.

* Performance goals presented here are based on restoration of existing dune habitat. If dune habitat is created, it may be necessary to create a separate set of performance goals specific to the created dune habitat.

4.9.3 Adaptive Management

The focus of dune restoration at the BWER is to provide habitat for unique plant and animal species, and given that these dune systems will lack the natural processes found in active dune systems, the focus of performance goals will be on the development of appropriate dune vegetation. Because much of the existing dune vegetation will be preserved, it is expected that restoration activities will focus on the removal of invasive species and subsequent planting of appropriate native plants. It is expected that trends in vegetation response to management activities will become apparent within two to three years following weed removal or planting.

If vegetation does not appear to be on a suitable trajectory toward meeting performance goals within two to three years following management activities, an assessment of long-term vegetation trends will be conducted to determine whether changes in management activities are warranted or whether performance goals should be modified based on an improved understanding of dune habitat development. If it is determined that trends in vegetation development are not on track to meet long-term performance goals, corrective management actions may be warranted, and an investigation into the causes of poor plant performance will be conducted. Potential corrective management actions may include the addition of slow-release fertilizer or other soil amendments, application of irrigation, more intensive weed management, or the use of sand stabilizing techniques such as installing sand fencing. Additional corrective management actions might include experimental seeding or planting techniques, trials to determine the best species for use in the dune restoration, or experimental methods of weed removal. Any such corrective management actions will be accompanied by monitoring designed to quantify and assess the outcomes.

4.10 Upland Scrub and Grassland

Within the context of the overall wetland restoration at the BWER, the goal of upland scrub and grassland habitat restoration is to create high-quality upland habitat to support tidal wetland functions. The primary support functions desired from upland habitat include (1) reducing overland flow rates, sediment loads, and contaminants for waters entering wetland habitat, (2) providing high quality nesting and high tide refuge areas for wildlife species, and (3) providing transition zones for sea level transgression. Monitoring and performance goals will focus on aspects related to the first two functions. The third function, providing transition zones for sea level transgression, will be achieved through the design process and should not require monitoring.

4.10.1 Monitoring

Monitoring of upland scrub and grassland habitats will include (1) measurements of total plant cover and plant diversity, (2) the location and cover of highly invasive species (i.e., Cal-IPC “High” or “Moderate” lists, exclusive of non-native annual grasses), and (3) use by a diversity of bird species for nesting, foraging, and other activities.

<u>Vegetation and Invasive Plants</u>

Vegetation monitoring will be conducted using a quantitative method (e.g., estimates of percent cover using quadrats) similar to that used to monitor vegetation elsewhere in the BWER. Monitoring will be designed to capture both the composition of vegetation and cover by individual plant species. Vegetation monitoring will commence near the end of the first full growing season following planting and will be conducted annually for the entire 10-year monitoring period. During annual vegetation monitoring, the location and extent of highly invasive weeds (i.e., plants on the Cal-IPC “High” or “Moderate” lists, exclusive of non-native annual grasses) will be documented on maps or aerial imagery. Whereas vegetation monitoring will be conducted over a limited area using a quantitative method, monitoring for invasive weeds will be conducted at a qualitative level, but will be conducted over the entire area of upland habitat. It may be useful to monitor for invasive weeds twice per year (or more frequently), once near the beginning of the growing season and again during the annual vegetation monitoring toward the end of the growing season (or more frequently). Because it will not be possible to eliminate propagule sources for non-native weeds which occur outside of the BWER, monitoring for invasive weeds will likely be required for the lifespan of the restoration.

<u>Bird Abundance and Diversity</u>

Monitoring for bird use of upland habitat will be conducted in conjunction with bird monitoring in other habitats at the BWER and will be consistent with the methods used elsewhere in the Reserve. Monitoring will be designed to capture (1) the abundance and species richness of birds observed using the upland habitat and (2) the activities in which the birds were engaged within the upland habitat (i.e., foraging, nesting, etc.).

Due to the large seasonal variation in bird migration and breeding patterns, monitoring for bird use of upland and transition habitats will be conducted at intervals throughout the year, with reduced monitoring during the summer breeding period to limit disturbance to breeding birds. Monitoring will be timed to occur during peak periods of bird activity. Because the ecological factors involved in bird use of upland habitat are based on a complex set of factors extending well beyond the limits of the BWER, this monitoring will be conducted every year during the 10-year monitoring period to capture the full range of variability and to compensate for stochastic events which may affect bird use in any given year.

4.10.2 Performance Goals

Performance goals for upland scrub and grassland habitats focus on (1) high cover and species richness of native plant species, (2) low cover of invasive plant species, and (3) use by a diversity of bird species.

<u>Vegetation and Invasive Plants</u>

Vegetation performance criteria presented here are aimed at documenting a steady increase in plant cover to meet the upland restoration objectives of providing erosion control, reducing overland flow rates and sediment and contaminant loads, and providing high quality habitat for use by wildlife species. The performance goals focus on the establishment of vegetative cover and a lack of highly invasive species. It is expected that upland habitats will contain a high percentage of non-native herbaceous species and, given the ample supply of weed seed sources in the surrounding areas, it is unlikely that these species will ever be fully controlled.

Table 16. Upland Scrub and Grassland Vegetation and Invasive Plant Performance Goals

Monitoring Year	Performance Goals
1 – 3	**A.** Canopy cover may be low, but vegetation should show signs of establishment and spread. **B.** Cover of invasive species listed as “High” or “Moderate” by the Cal-IPC, exclusive of annual grasses, should remain low.
4 – 7	**A.** Canopy cover should be relatively high, approaching 75% or greater by the end of Year 7, and should show signs of significant natural recruitment. **B.** Cover of invasive species listed as “High” or “Moderate” by the Cal-IPC, exclusive of annual grasses, should remain low.
8 – 10	**A.** Canopy cover should be nearly complete by the end of Year 10. **B.** Cover of invasive species listed as “High” or “Moderate” by the Cal-IPC, exclusive of annual grasses, should remain low.

Bird Abundance and Diversity

It is expected that many bird species will use upland scrub and grassland habitat, and although the primary wetland support function of the upland habitat is to provide high tide refuge for tidal marsh species, providing high quality habitat for non-aquatic birds is also an important function. The performance goals presented below are aimed at the presence of birds associated tidal marsh habitat as well as the presence of other birds using the habitat for foraging, roosting, and nesting—these birds may or may not be typically associated with tidal marsh habitat.

Table 17. Upland Scrub and Grassland Bird Performance Goals

Monitoring Year	Performance Goals
1 – 3	**A.** A variety of bird species should be observed foraging in the restored uplands, although the diversity and abundance of birds may be lower than observed prior to the restoration.
4 – 7	**A.** Species richness and abundance of birds should each be within pre-restoration levels and should be increasing with each successive year. **B.** Birds should be observed both foraging and demonstrating territorial behavior within the restored upland habitat.
8 – 10	**A.** Species richness and abundance of birds should each be greater than pre-restoration levels; however, annual increases may slow relative to increases observed in Years 4 – 7. **B.** Birds should be observed both foraging and demonstrating territorial behavior within the restored upland habitat.

4.10.3 Adaptive Management

The goal of upland habitat restoration at the BWER is to create high-quality habitat with support functions for tidal wetland habitat including reducing overland flow rates and sediment and contaminant loads, providing habitat for nesting and high tide refuge areas for wildlife species, and providing transition zones for sea level transgression. The primary focus of monitoring and performance goals for upland habitat is on the establishment of appropriate vegetation and use by wildlife species. It is expected that trends in the establishment of upland vegetation will be apparent within two to three years following planting or seeding. It is expected that trends in bird use may take somewhat longer to become apparent, on the order of three to five years.

If it is determined that trends in vegetation establishment or use by bird species are not on track to meet performance goals within the expected timeframe for trends to become apparent, an assessment of the overall trends in habitat development and use by wildlife will be conducted to determine whether the poor performance is specific to the BWER or occurs at a regional scale. If it is determined that the lack of progress toward meeting performance goals is specific to the BWER, the performance goals will be reevaluated in light of any improvements in our understanding of upland habitat development. If it is determined that the performance is not related to a deficiency in the performance goals, studies will be undertaken to determine the cause of the poor performance.

In terms of vegetation establishment, a lack of progress toward meeting performance goals is likely to be related to soil physical or chemical properties or moisture levels. Potential corrective management actions include additional plantings, installation of temporary irrigation (if not already present), addition of slow-release fertilizers, or addition of soil amendments to alter soil physical or chemical properties. Initial investigations indicate that salinity may be an issue in upland habitats. If it is determined that soil salinity is a cause of poor vegetation establishment, it may be necessary to modify the planting palette to include more salt-tolerant species (see the potential planting palette included as Appendix A). In terms of bird use of upland habitat, potential causes for a lack of progress toward meeting performance goals is likely to be related to vegetation composition or structure, the absence of suitable food sources, the presence of bird predators, or competition from non-native birds. Potential corrective management actions may include modifications vegetation structure or composition or management of predators or competing non-native birds.

4.11 Transition Zones

Although the habitats shown in Figure 4 are depicted with sharp boundaries between the adjacent habitats, in reality, each habitat will have a transition zone between it and the adjacent habitat. In some cases, these transition zones will be relatively narrow, such as the transition zone between tidal channels and tidal marsh habitat or the transition zone between seasonal wetland and upland grassland habitats. However, other transition zones are likely to be more broad, such as the transition zone between the high marsh and upland grassland and scrub habitats. In general, these transition zones will not be treated separately from their adjacent habitats, with one exception being the brackish marsh which represents a transition zone between saline and freshwater habitats. That said, it may be difficult to apply some performance goals to the transition zones, and in those cases, performance goals will be applied judiciously. In general, the focus of monitoring and assessments of performance in transition zones will be based on high levels of plant cover (if appropriate), low levels of invasive species, and low levels of problematic erosion or other disturbances.

4.12 Reserve-Wide Monitoring Elements

In addition to the habitat-specific monitoring parameters, a number of more general parameters will need to be monitored throughout the entire preserve. These parameters include erosion, public access, infrastructural conditions, litter, invasive species, and urban predators. Reserve-wide monitoring for these variables is discussed in the following sections. It may be most efficient to combine this monitoring with other elements of the monitoring program. Combining monitoring tasks will also help reduce disturbance to sensitive habitats or species at the BWER.

4.12.1 Erosion

Although erosion is likely to be more prevalent in certain habitats, it will be important to monitor for erosion throughout the BWER. Goals for erosion control will focus on preventing erosion and correcting any problematic erosion problems that do occur. Monitoring for erosion will occur on an annual basis, with particular emphasis during the rainy season. Monitoring will occur (1) within one month prior to the onset of seasonal rains and (2) on a monthly to bi-monthly basis following the onset of seasonal rains during the first several years of the restoration. The purpose of monitoring prior to the onset of seasonal rains is to document maintenance needs for existing erosion control measures as well as the need for any additional erosion control measures prior to the onset of the rainy season when erosion is expected to be greatest. The timing of this monitoring should be such that the land manager has sufficient time to perform maintenance or install additional controls prior to the onset of winter rains. The purpose of monthly monitoring during the rainy season is to document any areas of erosion and to identify the need for maintenance or additional control measures. Although these measures are useful for short-term erosion control during construction and the initial phases of vegetation establishment, long-term erosion control measures should be focused on the establishment of vegetative cover. Once vegetation communities have filled in sufficiently to reduce the potential for erosion, the frequency of monitoring may be reduced, but will occur no less than once per year during the entire 10-year monitoring period.

4.12.2 Public Access, Infrastructure, Litter

Public access at the BWER will be limited to roads, pedestrian trails, and designated public access areas such as picnic sites or wildlife viewing areas. Trash cans and recycling bins will be available throughout the BWER, and trash and other human debris will not be present in natural habitats. In addition, a trash boom will be installed within aquatic habitat to prevent the movement of trash to Ballona Creek. The surface of walkways and trails will be maintained in good, dry condition. Areas that flood or become muddy during the rainy season will be subject to seasonal closure or will be redesigned to prevent flooding. Trails will be free of large debris, and fencing and signage will be maintained in good condition. Social trails will not be present in any part of the Reserve. Given the relative ease of access to upland habitat relative to wetland habitat, human disturbance is likely to be a greater problem in upland habitat and will require regular monitoring and control.

Monitoring for these parameters may be qualitative in nature, but will occur over the full extent of the BWER, with particular focus in the upland areas and areas immediately adjacent to trails and other public access areas. During monitoring for human disturbance, the presence and extent of social trails, trash, and other debris will be documented on maps or aerial imagery. The condition of fencing, signage, and lighting will also be noted.

4.12.3 Invasive Species

Although monitoring for invasive plants is included in the monitoring program for individual habitats, it is included here to ensure that monitoring occurs throughout the Reserve. Monitoring for invasive weeds will be conducted at least twice annually during the initial 10-year monitoring period, once near the beginning of the growing season and again during early to mid-summer. More frequent monitoring may desirable given sufficient funds. Thereafter, monitoring will be conducted indefinitely into the future, at intervals to be determined based on data collected during the initial 10 years of monitoring. It is likely that uplands and freshwater habitats will require greater management for invasive weeds than will tidal wetland and salt panne habitats, and monitoring should be conducted more frequently in these habitats. Monitoring may be qualitative in nature and should document the location and approximate size of populations of invasive weeds listed by the Cal-IPC as “Moderate” or “High”, exclusive of grasses and the eucalyptus grove in Area B. Although complete eradication is unlikely for many species, the goal of weed control efforts at the Reserve should be to minimize impacts from invasive species. Existing populations of highly invasive species will be extirpated, to the extent feasible. New populations will be prevented from becoming established.

In addition to monitoring for invasive weeds, it may also be necessary to monitor for invasive wildlife species such as New Zealand mudsnail or American bullfrog (*Lithobates catesbeianus*). Although these species are not known to occur at the Reserve, there is potential for them to be introduced to the site. If these or other invasive wildlife species are observed at the site, a monitoring and eradication plan will be developed consistent with CDFW policies regarding such species.

4.12.4 Urban Predator Management

Given the urban setting in which the Reserve occurs, urban predators such as feral cats and raccoons are likely to pose significant threats to native wildlife in the Reserve. The presence of such urban predators may prevent the establishment of populations of wildlife species and will require control if wildlife performance goals are to be achieved. An urban predator monitoring and management plan will be developed in coordination with the CDFW. This plan will identify key areas for monitoring, trigger levels for management, and appropriate control methods. The plan will be administered by the CDFW or an appropriately licensed firm specializing in predator management.

4.12.5 Vector Control

Project proponents will work with the Los Angeles West County Vector Control District to ensure that vector concerns are addressed within the BWER. Any measures required to address vector concerns will be addressed in final plans.

4.13 Reporting

Timely reporting is a critical component of any monitoring and adaptive management program (Atkinson et al. 2004). Annual monitoring methods and results should be detailed in a report to be prepared for the SCC, the CDFW, the Corps, the Regional Water Quality Control Boards, and other interested parties. The exact content and formatting for monitoring reports will be informed by the CEQA/NEPA analysis and the regulatory permitting process. The annual monitoring report will present an analysis and discussion of the data collected over the previous year and will incorporate data and trends from previous years to create a complete picture of post-restoration habitat development. The analysis presented will be rigorous and detailed; however, the report should be written such that it can be understood by all parties involved in the restoration, whether they be technical experts or the general public.

In addition to the annual report, it may be necessary to produce brief monitoring memoranda for issues requiring rapid management decisions such as newly documented populations of invasive species, areas of severe erosion, or signs of human disturbance in sensitive habitats. The form of these brief reports will be developed in conjunction with the development of the HMMP.

4.14 Revisions to the Management Plan

Given the uncertainty involved in the development of many habitats at the Reserve, it may be necessary to modify the monitoring approach and performance goals presented here or those to be developed for the HMMP. Any modifications or additions to the monitoring approach or performance goals, or to the adaptive management program presented above will be supported by data collected at the BWER or the reference sites or from advances in our understanding of coastal habitat restoration. The triggers and process for implementing revisions to the management plan will be developed in coordination with the project design team and the CDFW and in conjunction with the development of the HMMP.

5.0 INFRASTRUCTURE PLANNING AND MANAGEMENT

The restoration and the long-term management of the BWER will require modifications to existing infrastructure and the addition of new infrastructure. The following sections outline the infrastructural requirements of both the restoration and the long-term management of the Reserve. This information is not intended to serve as a detailed analysis of the infrastructural requirements, but rather is intended to inform the development of a Property Analysis Record ("PAR") and an Operations and Maintenance Plan for the BWER. The PAR will be used to determine the funding required to conduct all of the proposed activities required for restoration, establishment, and long-term management.

5.1 Required Infrastructure for Restoration

A number of infrastructural elements may be required at the BWER in support of habitat restoration efforts. If on-site plant salvage and propagation is to occur, greenhouses and related facilities will be required. Multiple greenhouses may be required to provide space for the variety of plants needed for the restoration. Because of the infrastructural requirements for on-site plant salvage and propagation, it may be more cost-effective to outsource this work to a reputable native plant nursery or habitat restoration firm with plant propagation facilities. Temporary irrigation will be required in upland areas, transition zones, high marsh, and dune habitats where supplemental water will aid in the establishment of restoration plantings. Throughout the restoration, temporary staging areas will be required for plant and soil handling and other restoration-related tasks. In addition, temporary roads or travel ways will be required to transport restoration materials and equipment around the BWER; depending on the type of equipment to be used, these roads may require a surface treatment such as compacted gravel or geotextile fabric. It is likely that additional restoration-related infrastructural needs will be identified as the details of the restoration plan are developed.

5.2 Required Infrastructure for Long-Term Operations and Maintenance

5.2.1 Visitor Center

An interpretive visitor center is currently planned for development in Area C. The visitor center will serve as the public's main gateway to the BWER, providing educational resources on the functions and values of restored habitats and the importance of tidal wetland preservation. Plans for the visitor center are being developed by the project design team. Although the details of the visitor center have yet to be determined, it is clear that basic infrastructural elements will be necessary, including utilities, parking areas, pathways, fencing, and signage. Details on these elements will be provided in the project description for the visitor center.

5.2.2 Reserve Operations and Maintenance

The BWER will require long-term management and maintenance to ensure the success of restored habitats. Some of the major infrastructure required will likely include:

- Trails
- Gates
- Fencing
- Signage
- Interpretive panels
- Vehicles
- Maintenance workshop
- Machinery and hand tools

Other infrastructure, including a greenhouse to propagate plant material, may be required for successful operations and maintenance of the BWER and should be identified in the development of a long-term Operations and Maintenance Plan. The Operations and Maintenance Plan should provide detailed information on the planning, timing, and execution of yearly and periodic Reserve management tasks. The Plan should identify both up-front and on-going management tasks and the estimated costs of all tasks.

Following the preparation of a long-term Operations and Management Plan, a PAR will be performed to determine the financial requirements for managing and maintaining the BWER. All of the required management and maintenance needs of the Reserve identified in the Operations and Maintenance Plan will be analyzed in the PAR to determine the full cost of implementation.

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APPENDIX A

POTENTIAL PLANT PALETTE

Appendix A. Potential plant palette for wetland and upland restoration areas in BWER. Plant nomenclature follows Baldwin et al. (2012).

Scientific Name	Common Name	Life form	Conservation Status*	Salt Marsh	Mud flat	Low Marsh	Mid Marsh	High Marsh	Salt Pan	Low Transition	High Transition	Upland	Grass	Scrub	Dune	Seasonal Wetland	Freshwater / Brackish	Salt Tolerant	Landscape Suitable	Historically at BWER
Abronia latifolia	Sand verbena	Perennial forb										x			x					
Abronia maritima	Red sand verbena	Perennial forb	Rank 4								x	x			x			x		x
Abronia umbellata	Pink sand verbena	Perennial forb									x	x			x			x		x
Abronia villosa	Villose abronia	Annual herb										x			x			x		x
Acer macrophyllum	Big leaf maple	Tree										x	x						x	
Acer negundo	Boxelder	Tree										x					x		x	
Achillea millefolium	Common yarrow	Perennial forb									x	x	x	x					x	
Acmispon americanus	Spanish clover	Annual herb																		x
Acmispon argophyllus	Silver birds foot trefoil	Perennial herb										x	x	x						
Acmispon argyraeus	Canyon birdsfoot trefoil	Perennial herb										x	x	x						
Acmispon brachycarpus	Short podded lotus	Annual herb										x	x	x	x					
Acmispon dendroideus	Island broom	Shrub										x	x	x						
Acmispon glaber	Deerweed	Perennial shrub									x	x	x	x	x			x		x
Acmispon maritimus	Coastal lotus	Annual herb										x		x						
Acmispon strigosus	Strigose lotus	Annual herb										x	x	x	x					x
Adenostoma fasciculatum	Chamise	Perennial shrub										x								x
Agrostis exarata	Spike redtop	Perennial herb															x			
Alnus rhombifolia	White alder	Tree															x		x	
Amaranthus californicus	California amaranth	Annual herb															x			x
Amblyopappus pusillus	Dwarf coastweed	Annual herb																x		

Scientific Name	Common Name	Life form	Conservation Status*	Salt Marsh	Mud flat	Low Marsh	Mid Marsh	High Marsh	Salt Pan	Low Transition	High Transition	Upland	Grass	Scrub	Dune	Seasonal Wetland	Freshwater / Brackish	Salt Tolerant	Landscape Suitable	Historically at BWER
Ambrosia acanthicarpa	Annual bursage	Annual herb										x	x	x						x
Ambrosia chamissonis	Beach bur-sage	Perennial herb										x			x					x
Ambrosia psilostachya	Western ragweed	Perennial forb										x	x		x		x			x
Ammannia robusta	Grand redstem	Annual herb															x			
Amsinckia spectabilis	Seaside fiddleneck	Annual herb													x			x		
Anemopsis californica	Yerba mansa	Perennial herb																	x	x
Arenaria paludicola	Marsh sandwort	Perennial herb	FE, SE, Rank 1B	x		x	x	x									x	x	x	
Artemisia californica	California sage brush	Evergreen shrub										x		x	x			x	x	x
Artemisia douglasiana	Douglas' mugwort	Perennial forb									x									x
Artemisia dracunculus	Wild tarragon	Perennial forb										x		x	x				x	x
Artemisia palmeri	San Diego sage	Shrub	Rank 4									x	x	x				x		
Arthrocnemum subterminale	Parish's pickleweed	Perennial forb		x			x	x										x		x
Asclepias fascicularis	Narrow leaf milkweed	Perennial forb										x	x				x		x	
Astragalus pycnostachyus	Marsh milk vetch	Perennial herb		x														x		
Astragalus pycnostachyus var. lanosissimus	Ventura marsh milk vetch	Perennial forb	FE, SE, Rank 1B	x				x	x	x							x	x		
Astragalus tener	Alkali milk vetch	Annual herb									x	x	x		x	x	x	x		
Astragalus tener var. titi	Coastal dunes milk vetch	Annual forb	FE, SE, Rank 1B						x	x	x			x	x		x	x		
Astragalus trichopodus	Milk vetch	Perennial forb											x					x		x
Atriplex californica	California saltbush	Perennial								x	x							x		x

Scientific Name	Common Name	Life form	Conservation Status*	Salt Marsh	Mud flat	Low Marsh	Mid Marsh	High Marsh	Salt Pan	Low Transition	High Transition	Upland	Grass	Scrub	Dune	Seasonal Wetland	Freshwater / Brackish	Salt Tolerant	Landscape Suitable	Historically at BWER
		forb																		
Atriplex canescens	Fourwing saltbush	Perennial shrub												x				x		
Atriplex lentiformis	Large saltbush	Evergreen shrub									x	x	x	x				x		x
Atriplex pacifica	Pacific saltbush	Annual forb	Rank 1B											x	x					
Atriplex parryi	Parry'ss saltbush	Shrub										x		x		x	x	x	x	
Atriplex patula	Spear saltbush	Annual forb						x		x								x		x
Atriplex watsonii	Watson's saltbush	Perennial forb						x		x	x							x		
Baccharis glutinosa	Saltmarsh baccharis	Perennial forb								x								x		
Baccharis pilularis	Coyote brush	Evergreen shrub									x	x		x	x					x
Baccharis salicifolia	Mule fat	Evergreen shrub												x		x		x		x
Baccharis sarothroides	Broom baccharis	Perennial shrub												x				x		
Batis maritima	Saltwort	Evergreen shrub		x			x	x	x	x								x		
Bistorta bistortoides	American bistort	Perennial forb														x	x			
Bolboschoenus maritimus	Alkali bulrush	Perennial graminoid		x	x	x										x	x			x
Bolboschoenus maritimus subsp. paludosus	Saltmarsh bulrush	Perennial graminoid														x	x	x		
Bolboschoenus robustus	Robust bulrush	Perennial graminoid		x				x			x						x	x		x
Brickellia californica	California brickelbush	Perennial forb									x			x				x		x
Bromus arizonicus	Arizona brome	Annual graminoid										x	x							
Bromus carinatus	California brome	Annual graminoid																x		x
Bromus grandis	Tall brome	Perennial herb										x	x	x						
Bromus maritimus	Maritime brome	Perennial herb										x	x		x					

Scientific Name	Common Name	Life form	Conservation Status*	Salt Marsh	Mud flat	Low Marsh	Mid Marsh	High Marsh	Salt Pan	Low Transition	High Transition	Upland	Grass	Scrub	Dune	Seasonal Wetland	Freshwater / Brackish	Salt Tolerant	Landscape Suitable	Historically at BWER
Calystegia macrostegia	Southern California morning glory	Perennial vine										x		x	x					x
Calystegia sepium	Hedge bindweed	Perennial herb		x												x	x	x		
Calystegia soldanella	Beach morning glory	Perennial herb										x		x	x					
Camissoniopsis bistorta	California sun cup	Annual herb										x		x	x					x
Camissoniopsis cheiranthifolia	Beach evening primrose	Perennial forb										x	x	x	x			x		x
Camissoniopsis cheiranthifolia subsp. suffruticosa	Shrubby beach primrose	Perennial herb										x	x		x				x	x
Camissoniopsis lewisii	Lewis' evening primrose	Annual forb	Rank 3									x			x					x
Camissoniopsis micrantha	Spencer primrose	Annual herb										x	x		x				x	x
Carex barbarae	Santa Barbara sedge	Perennial graminoid									x	x	x	x		x		x	x	
Carex praegracilis	Clustered field sedge	Perennial graminoid															X		x	x
Carex spissa	San Diego sedge	Perennial graminoid															X		x	
Caulanthus lasiophyllus	California mustard	Annual herb										x	x	x						x
Centromadia parryi ssp. australis	Southern tarplant	Annual forb	Rank 1B									x	x	x		x		x	x	x
Chaenactis glabriuscula	Common yellow pincushion	Annual forb										x	x	x	x					x
Chaenactis glabriuscula var. glabriuscula	Common yellow pincushion	Annual forb										x	x	x	x					x
Chaenactis glabriuscula var. orcuttiana	Orcutt's yellow pincushion	Annual forb	Rank 1B									x	x	x	x					x
Chamerion angustifolium	Fireweed	Perennial forb										x		x			x			
Chenopodium berlandieri	Pitseed goosefoot	Annual forb										x							x	x
Chloropyron maritimum	Salt-marsh bird's beak	Annual herb		x								x			x			x		x
Chloropyron	Salt-marsh bird's beak	Annual	FE,	x								x			x			x		

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maritimum ssp. maritimum		herb	SE, Rank 1B																	
Clarkia purpurea	Winecup Clarkia	Annual herb										x	x	x						
Clematis ligusticifolia	Western white clematis	Vine / perennial forb										x					x			x
Corethrogyne filaginifolia	Common sandaster	Perennial forb										x		x	x					x
Cornus glabrata	Brown twig dogwood	Tree/ shrub										x	x				x			
Cornus sericea	American dogwood	Shrub															x		x	
Cornus sericea ssp. sericea	Creek dogwood	Shrub															x		x	
Crassula aquatica	Aquatic pygmyweed	Annual forb										x	x				x			
Crassula connata	Sand pygmyweed	Annual forb										x	x	x	x		x			x
Cressa truxillensis	Spreading alkali weed	Perennial forb		x			x	x					x			x		x		x
Croton californicus	California croton	Perennial forb									x	x	x	x	x			x		x
Croton setiger	Dove weed	Annual forb										x	x	x						
Cryptantha intermedia	Clearwater cryptantha	Annual forb										x		x						x
Cucurbita foetidissima	Missouri gourd	Vine / perennial forb										x	x	x	x					x
Cuscuta californica	California dodder	Parasitic vine										x	x	x						x
Cuscuta campestris	Field dodder	Parasitic vine										x	x	x	x					x
Cuscuta indecora	Large-seeded dodder	Parasitic vine										x	x			x	x			x
Cuscuta salina	Saltmarsh dodder	Parasitic vine		x			x	x		x										x
Cylindropuntia prolifera	Coastal cholla cactus	Succulent shrub										x		x						
Cyperus eragrostis	Tall flatsedge	Perennial forb										x					x			x
Cyperus erythrorhizos	Red rooted cyperus	Annual forb															x			

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Cyperus esculentus	Yellow nutgrass	Perennial forb										x					x			x
Cyperus laevigatus	Smooth cyperus	Perennial forb										x		x			x			
Cyperus niger	Black cyperus	Perennial forb										x		x			x			
Cyperus parishii	Parish's flatsedge	Perennial forb										x		x			x			
Cyperus squarrosus	Awned cyperus	Annual forb															x			
Datura wrightii	Jimsonweed	Perennial forb										x	x	x						x
Deinandra fasciculata	Clustered tarweed	Annual forb										x	x	x						x
Deinandra kelloggii	Kellog's tarweed	Annual forb										x	x							
Deinandra paniculata	Paniculate tarplant	Annual forb	Rank 4									x	x	x					x	x
Dichondra occidentalis	Western dichondra	Perennial forb	Rank 4									x	x	x						x
Distichlis littoralis	Shore grass	Perennial graminoid		x				x	x									x		
Distichlis spicata	Spiked saltgrass	Perennial graminoid		x			x	x		x								x		x
Dudleya caespitosa	Sand lettuce	Perennial succulent										x	x	x	x				x	
Dudleya lanceolata	Southern California dudleya	Perennial succulent										x		x						
Dudleya palmeri	Palmer's dudleya	Perennial succulent										x		x						
Dudleya pulverulenta	Chalk dudleya	Perennial succulent										x		x					x	
Dudleya virens	Bright green dudleya	Perennial succulent										x		x						
Eleocharis coloradoensis	Rush	Perennial graminoid		x			x	x		x	x					x	x	x	x	
Eleocharis macrostachya	Longstem spike-rush	Perennial graminoid		x			x	x		x	x						x	x		x
Eleocharis montevidensis	Montevideo spike-rush	Perennial graminoid															x			x
Elymus condensatus	Giant rye grass	Perennial graminoid										x	x	x					x	x
Elymus triticoides	Creeping wild rye	Perennial									x	x	x			x		x		

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		graminoid																		
Encelia californica	California brittlebush	Shrub										x	x	x	x				x	x
Encelia farinosa	Brittlebush	Shrub										x		x						
Epilobium brachycarpum	Annual fireweed	Annual forb										x	x							
Epilobium campestre	Smooth boisduvalia	Annual forb										x	x	x			x			
Epilobium canum	California fuschia	Perennial forb										x		x						
Epilobium ciliatum	Fringed willow herb	Perennial forb										x	x	x			x			x
Epilobium densiflorum	Dense flowered spike primrose	Annual forb										x	x	x						
Epipactis gigantea	Stream orchid	Perennial forb															x			
Equisetum telmateia ssp. braunii	Giant horsetail	Fern															x			
Ericameria arborescens	Golden fleece	Shrub										x		x					x	
Ericameria ericoides	California goldenbush	Shrub										x		x	x			x		x
Ericameria palmeri	Palmer's goldenweed	Shrub										x		x						
Ericameria pinifolia	Pine bush	Shrub										x		x						x
Erigeron canadensis	Canadian horseweed	Annual herb										x								x
Eriodictyon trichocalyx	Yerba santa	Shrub										x		x					x	
Eriogonum cinereum	Coast ashyleaf buckwheat	Shrub										x		x	x				x	
Eriogonum elongatum	Longstem buckwheat	Perennial forb										x		x						
Eriogonum fasciculatum	California buckwheat	Shrub												x	x					x
Eriogonum giganteum	St. Catherine's lace	Shrub										x		x						
Eriogonum gracile	Slender buckwheat	Annual graminoid										x	x	x						x
Eriogonum gracillimum	Rose and white buckwheat	Annual forb										x	x	x						
Eriogonum grande	Island buckwheat	Perennial forb										x		x						

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Eriogonum nudum	Nude buckwheat	Shrub										x	x	x						
Eriogonum parvifolium	Dune buckwheat	Shrub										x		x	x				x	x
Eriogonum viridescens	Bright green buckwheat	Annual forb										x	x	x						
Eriophyllum confertiflorum	Golden yarrow	Shrub										x		x					x	
Eryngium aristulatum	California eryngo	Perennial herb														x				
Erysimum capitatum var. capitatum	Sand dune wallflower	Perennial herb										x		x	x					
Erysimum suffrutescens	Suffrutescent wallflower	Perennial forb	Rank 4									x			x					x
Eschscholzia californica	California poppy	Annual/per ennial herb										x			x			x	x	x
Euphorbia albomarginata	Rattlesnake weed	Perennial forb										x	x	x						x
Euphorbia crenulata	Chinese caps	Annual/per ennial herb										x	x	x						
Euphorbia melanadenia	Spurge	Perennial forb										x								
Euphorbia polycarpa	Small-seeded spurge	Perennial forb										x		x						x
Euphorbia serpens	Creeping spurge	Annual forb															x			
Euthamia occidentalis	Western goldenrod	Perennial forb		x				x		x								x		
Festuca californica	California fescue	Perennial herb										x	x							
Festuca microstachys	Small fescue	Annual herb										x	x	x				x		
Festuca octoflora	Sixweeks grass	Perennial graminoid										x	x							
Festuca rubra	Red fescue	Perennial graminoid										x	x							
Frangula californica	California coffeeberry	Shrub										x								
Frankenia salina	Alkali heath	Perennial forb		x			x	x	x	x	x							x		x
Fraxinus velutina	Velvet Arizona ash	Tree										x								x
Galium angustifolium	Narrow-leaved bedstraw	Perennial herb																		x

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Gambelia speciosa	Island snapdragon	Shrub										x		x					x	
Gnaphalium palustre	Western marsh cudweed	Annual herb										x	x			x	x			x
Grindelia camporum	Common gum plant	Perennial herb											x							x
Grindelia hirsutula	Gumweed	Perennial herb												x						
Grindelia stricta	Coastal gumweed	Perennial herb		x																
Hazardia squarrosa	Saw-toothed hazardia	Perennial shrub											x	x				x		
Helianthus annuus	Common annual sunflower	Annual herb										x	x	x					x	x
Heliotropium curassavicum	Seaside heliotrope	Perennial forb		x				x	x	x								x		x
Hesperoyucca whipplei	Whipple's yucca	Shrub										x		x						
Heteromeles arbutifolia	Toyon	Evergreen shrub											x	x						x
Heterotheca grandiflora	Telegraph weed	Annual/perennial forb										x		x						x
Heterotheca sessiliflora	Golden aster	Annual/perennial forb										x	x	x						
Heterotheca villosa	Villous golden-aste	Perennial forb										x		x			x			x
Hoffmannseggia glauca	Waxy hoffmannseggia	Perennial forb														x		x		x
Hordeum brachyantherum	Meadow barley	Perennial graminoid									x	x	x			x	x	x		
Hordeum brachyantherum ssp. californicum	California barley	Perennial graminoid										x	x	x		x	x			
Hordeum depressum	Alkali barley	Annual graminoid								x	x	x	x			x		x		x
Hordeum intercedens	Bobtail barley	Annual graminoid	Rank 3									x	x			x	x			
Hordeum jubatum	Fox tail barley	Perennial graminoid										x				x	x			
Hypericum anagalloides	Tinker's penny	Annual/perennial herb														x	x	x		
Isocoma menziesii	White flowered	Shrub										x			x					x

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	goldenbush																			
Isocoma menziesii var. vernonioides	Coastal goldenbush	Shrub									x	x	x	x	x	x	x	x		
Isolepis cernua	Low bulrush	Annual graminoid					x									x		x		
Isomeris arborea	Bladder pod	Perennial shrub										x		x				x		
Iva axillaris	Poverty weed	Perennial forb		x					x		x	x	x					x		
Jaumea carnosa	Fleshy jaumea	Perennial forb		x	x	x	x										x	x		x
Juglans californica	California black walnut	Tree	Rank 4									x								
Juncus acutus	Spiny rush	Perennial graminoid		x	x	x	x									x	x	x		x
Juncus acutus ssp. leopoldii	Spiny rush	Perennial graminoid	Rank 4							x						x	x	x		x
Juncus ambiguus	Saline toad rush	Perennial graminoid														x	x			
Juncus balticus	Baltic rush	Perennial graminoid		x	x	x	x			x						x	x	x		x
Juncus bufonius	Common toad-rush	Annual graminoid						x	x	x						x	x	x		x
Juncus bufonius var. *occidentalis*	Western toad rush	Perennial graminoid														x	x			x
Juncus effusus	Common bog rush	Perennial graminoid		x		x	x	x		x	x					x	x	x		
Juncus macrophyllus	Longleaf rush	Perennial graminoid														x	x			
Juncus mexicanus	Mexican rush	Perennial graminoid		x	x	x	x	x		x						x	x	x	x	x
Juncus patens	Common rush	Perennial graminoid														x	x	x	x	
Juncus textilis	Basket rush	Perennial graminoid										x		x					x	
Juncus xiphioides	Iris leaved rush	Perennial graminoid														x	x		x	
Laennecia coulteri	Coulter's horseweed	Annual herb														x	x	x		x
Lasthenia glabrata	Yellow ray goldfields	Annual herb									x	x				x		x	x	

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Lasthenia glabrata var. coulteri	Coulter's goldfields	Annual forb							x							x				
Layia platyglossa	Common tidy tips	Annual forb										x	x	x		x			x	
Lepidium virginicum ssp. menziesii	Robinson's pepper grass	Annual forb										x	x	x						x
Leptochloa fusca ssp. uninervia	Mexican sprangle top											x	x	x		x				x
Leptosyne gigantea	Giant coreopsis	Shrub										x		x						
Lilium humboldtii	Humboldt's lily	Perennial herb										x		x					x	
Limonium californicum	Sea lavender	Perennial forb		x			x	x		x	x	x				x	x	x		x
Lupinus arboreus	Coastal bush lupine	Shrub										x		x	x				x	
Lupinus bicolor	Bicolored lupine	Annual/perennial herb																x	x	x
Lupinus chamissonis	Coastal bush lupine	Evergreen shrub										x		x	x				x	x
Lupinus excubitus var. hallii	Hall's bush lupine	Shrub										x		x					x	x
Lupinus latifolius	Broadleaf lupine	Perennial herb															x		x	
Lupinus longifolius	Longleaf bush lupine	Shrub										x		x					x	x
Lupinus succulentus	Arroyo lupine	Annual herb										x	x						x	x
Lupinus truncatus	Truncate-leaved lupine	Annual herb										x	x	x					x	x
Lycium californicum	California boxthorn	Shrub								x	x	x		x				x		
Malacothamnus fasciculatus	Bushmallow	Shrub										x		x				x		x
Malacothrix saxatilis	Cliff aster	Perennial forb										x		x	x					x
Malosma laurina	Laurel sumac	Tree / shrub										x		x						x
Malvella leprosa	Alkali mallow	Perennial forb										x	x	x		x	x			x
Melica imperfecta	Small-flowered melic grass	Perennial graminoid										x	x	x						x
Mimulus aurantiacus	Sticky monkeyflower	Shrub										x	x	x					x	

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Mimulus cardinalis	Scarlet monkeyflower	Perennial herb														x	x		x	
Mimulus guttatus	Common yellow monkeyflower	Annual/perennial herb														x	x		x	
Mimulus latidens	Broad toothed monkeyflower	Annual herb										x	x			x	x		x	
Mimulus moschatus	Musk monkeyflower	Perennial herb														x	x		x	
Mimulus pilosus	Downy monkeyflower	Annual herb										x					x		x	
Muhlenbergia rigens	Deergrass	Perennial herb										x	x						x	
Nemophila maculata	Five spot	Annual forb										x	x							
Nemophila menziesii	Baby blue eyes	Seasonal wildflower										x	x	x					x	
Nemophila pedunculata	Meadowfoot nemophilia	Annual forb										x	x			x	x			
Oenothera elata	Hooker's evening primrose	Perennial forb										x	x		x	x	x	x		
Oenothera elata ssp. hirsutissima	Hairy evening primrose	Perennial forb														x	x			x
Oenothera elata ssp. hookeri	Common evening primrose	Perennial forb										x		x	x	x	x			x
Opuntia basilaris	Beavertail cactus	Succulent shrub										x		x					x	
Opuntia littoralis	Coastal prickly pear	Succulent shrub										x		x					x	x
Paspalum distichum	Knot grass	Perennial herb					x	x		x		x	x			x	x	x		
Penstemon centranthifolius	Scarlet bugler	Perennial forb										x								
Penstemon heterophyllus	Foothill penstemon	Perennial forb										x								
Penstemon spectabilis	Showy penstemon	Perennial forb										x							x	
Persicaria hydropiperoides	Water pepper	Perennial forb														x	x			
Persicaria lapathifolia	Willow weed	Annual forb										x	x	x		x	x			x
Persicaria punctata	Dotted smartweed	Perennial forb														x	x			

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Petunia parviflora	Wild petunia	Annual forb										x	x			x	x			x
Phacelia brachyloba	Short lobed phacelia	Annual forb										x		x						
Phacelia cicutaria	Caterpillar phacelia	Annual forb										x	x	x						
Phacelia distans	Common phacelia	Annual forb										x	x							
Phacelia douglasii	Douglas' phacelia	Annual forb										x	x	x						
Phacelia fremontii	Fremont's phacelia	Annual forb										x	x	x						
Phacelia minor	California bluebell	Annual forb										x		x						
Phacelia ramosissima	Branching phacelia	Perennial forb									x	x	x	x	x			x		x
Phacelia stellaris	Star phacelia	Annual forb	Rank 1B									x		x	x					
Phyla lanceolata	Lance leaf lippia	Perennial forb									x	x	x			x	x			
Phyla nodiflora	Common lippia	Perennial forb														x	x		x	
Plantago erecta	Foothill plantain	Annual forb										x	x	x						
Plantago subnuda	Tall coastal plantain	Perennial herb														x	x			
Platanus racemosa	Western sycamore	Deciduous tree										x		x		x				
Pluchea odorata	Marsh fleabane	Perennial forb						x		x								x		
Poa secunda	Pine bluegrass	Perennial herb										x	x							
Populus fremontii	Fremont cottonwood	Deciduous tree												x		x				x
Potentilla anserina subsp. pacifica	Silverweed	Perennial forb						x		x	x							x		
Prunus ilicifolia ssp. ilicifolia	Holly-leaf cherry	Tree/ shrub										x		x					x	
Pseudognaphalium beneolens	Cudweed	Perennial forb										x	x	x	x					x
Pseudognaphalium biolettii	Two-color rabbit-tobacco	Perennial herb										x	x	x	x					
Pseudognaphalium californicum	Ladies' tobacco	Annual/perennial herb										x	x	x						x
Pseudognaphalium	Wright's cudweed	Perennial										x			x					x

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microcephalum		herb																		
Pseudognaphalium ramosissimum	Pink cudweed	Biennial herb										x	x	x	x					x
Pseudognaphalium stramineum	Cottonbatting plant	Perennial herb										x	x	x	x					x
Quercus agrifolia	Coast live oak	Tree										x								x
Quercus berberidifolia	Scrub oak	Tree										x		x						
Rhamnus ilicifolia	Hollyleaf redberry	Shrub										x		x					x	
Rhus aromatica	Skunkbush	Shrub										x								
Rhus integrifolia	Lemonade berry	Shrub										x		x					x	
Rhus ovata	Sugar bush	Shrub																		x
Ribes aureum	Golden currant	Shrub										x							x	
Ribes californicum	California gooseberry	Shrub										x							x	
Ribes malvaceum	Chaparral currant	Shrub										x		x					x	x
Ribes speciosum	Fuchsia flowering gooseberry	Shrub										x							x	
Rosa californica	California wild rose	Shrub									x	x	x	x				x	x	x
Rubus ursinus	California blackberry	Vine										x								
Rumex californicus	California dock	Perennial herb														x	x	x		
Rumex crassus	Willow leaved dock	Perennial herb										x			x		x			
Rumex fueginus	Golden dock	Annual/perennial herb														x	x	x		x
Rumex persicarioides	Dock	Annual/perennial herb						x				x			x			x		
Rumex salicifolius	Willow dock	Perennial herb								x		x	x			x		x		x
Ruppia cirrhosa	Spiral ditch grass	Perennial herb			x												x	x		
Ruppia maritima	Ditch grass	Perennial herb			x												x	x		x
Sagittaria montevidensis	Giant arrowhead	Perennial herb															x			
Sagittaria	Montevideo	Perennial															x			x

Scientific Name	Common Name	Life form	Conservation Status*	Salt Marsh	Mud flat	Low Marsh	Mid Marsh	High Marsh	Salt Pan	Low Transition	High Transition	Upland	Grass	Scrub	Dune	Seasonal Wetland	Freshwater / Brackish	Salt Tolerant	Landscape Suitable	Historically at BWER
montevidensis subsp. calycina	arrowhead	herb																		
Salicornia bigelovii	Annual pickleweed	Annual forb		x			x	x	x									x		
Salicornia depressa	Virginia glasswort	Annual herb		x												x		x		
Salicornia pacifica	Common pickleweed	Perennial forb		x			x	x										x		x
Salix exigua	Narrow-leaved willow	Deciduous shrub										x				x				
Salix gooddingii	Black willow	Tree															x			x
Salix laevigata	Red willow	Tree															x	x		x
Salix lasiolepis	Arroyo willow	Deciduous shrub														x				x
Salix melanopsis	Dusky willow	Tree / shrub															x			
Salvia apiana	White sage	Perennial shrub										x		x				x	x	
Salvia leucophylla	Purple sage	Shrub										x		x					x	
Salvia mellifera	Black sage	Perennial shrub										x		x				x	x	
Salvia spathacea	Hummingbird sage	Perennial herb										x					x	x	x	
Sambucus nigra	Black elderberry	Deciduous shrub												x		x			x	
Sambucus nigra subsp. caerulea	Blue elderberry	Shrub										x							x	
Sambucus nigra subsp. canadensis	Blue elderberry	Shrub										x							x	
Schoenoplectus acutus	Hard stem bulrush	Perennial herb		x	x	x										x	x			
Schoenoplectus americanus	Chairmaker's bulrush	Perennial herb														x	x			x
Schoenoplectus californicus	California tule	Perennial graminoid		x	x	x										x	x	x		x
Scirpus californicus	California bulrush	Perennial herb		x							x						x	x		
Sesuvium verrucosum	Western sea-purslane	Perennial herb										x	x	x		x	x			x
Setaria parviflora	Bristlegrass	Perennial										x	x	x						x

Scientific Name	Common Name	Life form	Conservation Status*	Salt Marsh	Mud flat	Low Marsh	Mid Marsh	High Marsh	Salt Pan	Low Transition	High Transition	Upland	Grass	Scrub	Dune	Seasonal Wetland	Freshwater / Brackish	Salt Tolerant	Landscape Suitable	Historically at BWER
		graminoid																		
Silene laciniata	Mexican silene	Perennial forb										x		x						
Sisyrinchium bellum	Western blue-eyed grass	Perennial graminoid										x	x						x	
Solanum americanum	American black nightshade	Annual/perennial forb															x			x
Solanum douglasii	Douglas's nightshade	Perennial forb										x		x	x	x	x			x
Solanum umbelliferum	Blue witch	Shrub										x	x	x						
Solanum xanti	Nightshade	Shrub / perennial forb										x		x						x
Solidago velutina subsp. californica	California goldenrod	Perennial herb									x	x	x	x						x
Spartina foliosa	Cordgrass	Perennial graminoid		x	x	x												x		
Spergularia macrotheca	Sticky sand spurry	Perennial herb		x				x		x		x		x			x			x
Spergularia marina	Salt marsh sand spurry	Perennial herb		x				x		x					x		x			x
Stephanomeria exigua	Small wire lettuce	Annual forb										x		x						x
Stephanomeria virgata	Tall stephanomeria	Annual forb										x	x	x						x
Stipa cernua	Nodding needlegrass	Perennial graminoid										x	x	x						x
Stipa coronata	Crested needlegrass	Perennial graminoid										x	x	x						
Stipa lepida	Foothill needle grass	Perennial graminoid										x	x	x						
Stipa pulchra	Purple needle grass	Perennial graminoid										x	x	x					x	
Suaeda calceoliformis	Horned sea blite	Annual herb														x		x		x
Suaeda californica	California sea blite	Shrub		x													x	x		
Suaeda esteroa	Estuary sea-blite	Perennial forb		x			x	x										x		x
Suaeda nigra	Seepweed	Perennial forb								x	x					x		x		

Scientific Name	Common Name	Life form	Conservation Status*	Salt Marsh	Mud flat	Low Marsh	Mid Marsh	High Marsh	Salt Pan	Low Transition	High Transition	Upland	Grass	Scrub	Dune	Seasonal Wetland	Freshwater / Brackish	Salt Tolerant	Landscape Suitable	Historically at BWER
Suaeda taxifolia	Woolly seablite	Evergreen shrub		x				x	x	x		x	x		x	x		x		x
Symphoricarpos albus	Common snowberry	Shrub										x							x	
Symphoricarpos mollis	Trailing snowberry	Shrub										x							x	
Symphyotrichum subulatum	Annual saltmarsh aster	Annual herb		x				x										x		
Thalictrum fendleri var. polycarpum	Fendler's meadow rue	Perennial forb										x							x	
Trichostema lanatum	Woolly bluecurls	Shrub										x		x					x	
Triglochin concinna	Arrow grass	Perennial herb		x	x	x	x	x									x	x		
Triglochin maritima	Seaside arrow grass	Perennial forb		x	x	x	x	x									x	x		
Typha domingensis	Southern cattail	Perennial herb		x	x	x											x			x
Typha latifolia	Common cattail	Perennial forb															x			x
Urtica dioica ssp. holosericea	Hoary nettle	Perennial forb										x	x	x		x	x			x
Verbena bracteata	Bigbract verbena	Annual/perennial forb										x	x			x	x			
Verbena lasiostachys	Common verbena	Perennial forb										x	x			x	x			x
Verbena lasiostachys subsp. lasiostachys	Western vervain	Perennial forb														x	x			
Verbena lasiostachys subsp. scabrida	Robust vervain	Perennial forb										x				x	x			
Verbena scabra	Rough vervain	Perennial forb										x	x	x		x	x			
Woodwardia fimbriata	Giant chain fern	Fern											x			x	x			
Xanthium spinosum	Spiny cocklebur	Annual forb														x	x			x
Xanthium strumarium	Rough cocklebur	Annual forb														x	x			x

*Key to Conservation Status:

FE Federal endangered

SE State endangered

Rank 1B California Rare Plant Rank 1B: Plants rare, threatened, or endangered in California and elsewhere

Rank 3 California Rare Plant Rank 3: Plants about which we need more information—a review list

Rank 4 California Rare Plant Rank 4: Plants of limited distribution—a watch list

APPENDIX B

RESULTS OF INITIAL SOIL ANALYSES

San Jose Office
October 25, 2012
Report 12-286-0052

WRA Environmental
2169-G E. Francisco Blvd.
San Rafael, CA 94901

Attn: Tanner Harris

RE: Ballona Wetlands

Background

The eight samples received October 12, 2012 were identified as representing site soil. The samples were taken from various depths (topsoil to middle subsoil to deep subsoil). The soil will be used primarily for upland restoration planting at the Ballona Wetlands. The samples were analyzed for horticultural suitability, fertility, and physical characteristics. The results of the analyses are attached.

Analytical Results

Topsoil (0-1')

The reaction of the soils is slightly alkaline at a pH of 7.6 for A-HSA016, 7.4 for A-HSA017, and 7.3 for A-HSA018. Low qualitative lime is present in all three samples, which can buffer the pH in the alkaline region.

Salinity (ECe), sodium, and boron are safely low in all three of the topsoil samples. The sodium adsorption ratios (SAR) show sodium adequately balanced by soluble calcium and magnesium; this balance is important for soil structure and how it relates to water infiltration in these soils.

The texture of A-HSA016 and A-HSA017 is loamy sand. A-HSA018 is loam. Textures were determined according to the USDA Soil Classification system. Organic matter is low, but typical of native soils. The estimated infiltration rates are favorable in all areas at 0.46 inch per hour for A-HSA016 and A-HSA017 and 0.32 inch per hour for A-HSA018. Infiltration rates may vary due to the potential differences in compaction across the areas.

In terms of fertility, nitrogen is lower than preferred even for native plants. Phosphorus is fair to low in these three samples. Zinc is lower than preferred in each sample as well. Magnesium is fair in A-HSA016 and A-HSA017. The remaining nutrients are adequate for proper plant nutrition.

Middle Subsoil (6.5-8')

The reaction of the soils is moderately alkaline at a pH of 8.2 for A-HSA016 and 7.9 for A-HSA017. No soil for this middle depth was submitted for A-HSA018. Low qualitative lime is present in both samples, which can buffer the pH in the alkaline region.

Salinity and sodium are elevated in both of the samples. Levels present are typical of salt marsh conditions. The sodium adsorption ratios (SAR) show sodium inadequately balanced by soluble calcium and magnesium. This imbalance can affect soil structure and reduce water infiltration in these soils if used outside of a marsh setting. Boron is slightly elevated in A-HSA016, but is safely low for most plants in A-HSA017.

The texture of A-HSA016 is sandy loam and A-HSA017 is a loam. Textures were determined according to the USDA Soil Classification system. Organic matter is low, but typical of native soils. The estimated infiltration rates are favorable in both areas at 0.37 inch per hour for A-HSA016 and 0.32 inch per hour for A-HSA017. Infiltration rates may vary due to the potential differences in compaction across the areas.

In terms of fertility, nitrogen, calcium, and zinc are lower than preferred even for native plants. Phosphorus is low in A-HSA017. Potassium is abundant in both samples. The remaining nutrients are adequate for proper plant nutrition.

<u>Deep Subsoil (15-19')</u>

The reaction of the soils is moderately alkaline at a pH of 7.8 for A-HSA016 and 018. A pH of 7.9 is present in the A-HSA017 soil. Low qualitative lime is present in all three samples, which can buffer the pH in the alkaline region.

Salinity and sodium are elevated in all of the samples. Levels present are typical of salt marsh conditions. The sodium adsorption ratios (SAR) show sodium inadequately balanced by soluble calcium and magnesium. This imbalance can affect soil structure and reduce water infiltration in these soils if used outside of a marsh setting. Boron is slightly elevated in A-HSA016 and 018. In A-HSA017 the boron level is somewhat elevated.

The texture of all three soils is sand as determined by the USDA Soil Classification system. Organic matter is low, but typical of native soils. The estimated infiltration rates are favorable ranging from 0.30-0.32 inch per hour. Infiltration rates may vary due to the potential differences in compaction across the areas.

In terms of fertility, nitrogen, phosphorus, and calcium are lower than preferred even for native plants. Zinc is lower than preferred in A-HSA016 and 018. The remaining nutrients are adequate for proper plant nutrition.

Comments

The topsoil samples (0-1') appear suitable for most upland plants except those that prefer particularly acidic conditions. The loamy sands will not hold as much water and nutrients as the loam textured soil in A-HSA018. Irrigations requirements will likely differ between these two soil textures during plant establishment. Incorporation of an organic amendment such as a composted greenwaste can help to improve the soil quality in both soils and provide some nutrients (phosphorus and zinc) without over fertilizing. A slow release nitrogen fertilizer could be added at a moderate rate, if the composted greenwaste does not provide some nitrogen.

The middle and deep subsoil samples have salinity, sodium, and SAR values that are characteristic of salt marsh soils where plants such as pickleweed and saltgrass inhabit. For tidal marsh plantings, a moderate amount of composted greenwaste could be used to slightly improve conditions and jump start the organic matter cycling process. However, for upland species, much remediation would be needed. Leaching the soil to decrease the salinity and sodium to levels that are tolerable for most upland species (with low to moderate salt tolerance) will require significant amounts of gypsum and good quality water (low in salts). Several applications of gypsum will likely be needed to provide enough calcium to displace the sodium in the soil. Good drainage will be needed so the salts can be removed from the root zone. Since the soils are loamy in texture with higher amounts of silt and clay leaching will likely only be feasible for to reduce the salts in the top several inches of soil where ground cover with some salt tolerance would be planted. Reduction of the salts will take some time as approximately 1-2 foot of water would be needed to reduce the salinity and sodium to more suitable levels. After leaching has occurred, composted greenwaste and a slow release nitrogen fertilizer could be added to the soils to improve planting conditions. Trees and shrubs would be better suited in the topsoil materials.

The pH of these buried middle and deep soils could change due to the sulfur content and the exposure to oxygen. As the sulfur is oxidized a formation of acidic compounds could occur, which could decrease the soil pH values to very acidic levels. These soils are currently being examined for acid-base accounting to determine the acid forming potential and the natural neutralization potential to counter act that pH change. The results of these analyses will be presented as soon as they are available.

Recommendations

Leaching:

Recommendations presented below are to bring salinity levels to ~3.5 dS/m in the top 6 inches of soil, which is favorable for all but the most salt sensitive groundcover plants. The gypsum amounts should be applied and incorpoated several times over the leaching period to reduce the SAR to ~5. *Depending on the salt tolerance of the plants, these low of levels for salinity and SAR may not be necessary.* Retesting the soil for salinity, sodium, and SAR (test A02) may be beneficial to determine the current levels of these constituents.

Once the material has been laid to final grade, the following material should then be evenly spread and thoroughly blended with the top 6 inches of soil to form a homogenous layer:

	Amount / 1000 Square Feet	Amount of Water to be Applied
A-HSA016 8'	90 pounds Agricultural Gypsum (3 times)	13 inches
A-HSA016 17'	100 pounds Agricultural Gypsum (5 times)	20 inches
A-HSA017 6.5'	95 pounds Agricultural Gypsum (3 times)	15 inches
A-HSA017 15'	95 pounds Agricultural Gypsum (5 times)	19 inches
A-HSA018 17-19'	105 pounds Agricultural Gypsum (2 times)	20 inches

To Prepare For Mass Planting (Post Leaching):

The following materials or similar should then be evenly spread and thoroughly blended with the top 6 inches of soil to form a homogenous layer:

	Amount / 1000 Square Feet	
All Soils	3-4 cubic yards	Composted Greenwaste*
Upland Soil Planting	8 pounds	Feather Meal (13-0-0)*

*The rate may change based on the analysis of the chosen organic amendment. This rate is based on 270 lbs dry weight of organic matter/ cu. yd. of amendment. If a composted greenwaste is used, that contains a moderate amount of nitrogen, omit the feather meal.

To Prepare Backfill For Trees and Shrubs with *Topsoil (0-1') only*:

- Excavate planting pits at least twice as wide as the diameter of the rootball.
- Soil immediately below the root ball should be left undisturbed to provide support but the sides and the bottom around the side should be cultivated to improve porosity.
- The top of the rootball should be at or slightly above final grade.
- The top 12-inches of backfill around the sides of the rootball of trees and shrubs may consist of the above amended soil or may be prepared as follows:

	4-5 parts	Soil
	1 part	Composted Greenwaste*
Uniformly blended with:		
	Amount / Cubic Yard of Backfill Mix	
Upland Planting	1/3 pound	Feather Meal (13-0-0)

- Backfill below 12 inches should not contain the organic amendment.
- Irrigation of new plantings should take into consideration the differing texture of the rootball substrate and surrounding soil matrix to maintain adequate moisture during this critical period of establishment.

If we can be of any further assistance, please feel free to contact us.

Meagan Hynes, Ph.D., APSS
Emailed 6 Pages: harris@wra-ca.gov

WRA Environmental
2169-G E. Francisco Blvd.

San Rafael CA 94901

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4741 E. Hunter Ave, Suite A Anaheim, CA 92807 714-282-8777 (phone) 714-282-8575 (fax)
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Project : Ballona Wetlands

Report No : **12-286-0052**
Purchase Order :
Date Recd : 10/12/2012
Date Printed : 10/19/2012

COMPREHENSIVE SOIL ANALYSIS

Sample Description - Sample ID	Half Sat % / TEC	pH / Qual Lime	ECe dS/m	NO_3-N ppm	NH_4-N ppm	PO_4-P ppm	K ppm	Ca ppm	Mg ppm	Cu ppm	Zn ppm	Mn ppm	Fe ppm	Organic % dry wt.	Lab No.
				Sufficiency Factors											
A-HSA016 0-1'	19	7.6	1.1	6	5	13	173	1289	127	1.1	0.2	6	30	1.5	20444
	77	Low		0.3		0.6	1.4	1.0	0.7	1.1	0	0.7	0.8		
A-HSA016 8'	19	8.2	26.3	5	8	17	448	1093	655	1.9	1.1	28	88	1.5	20445
	129	Low		0.3		0.7	2.7	0.5	2.3	1.1	0.2	1.9	1.4		
A-HSA016 17'	27	7.8	30.0	9	15	21	584	1327	1076	2.0	2.4	56	80	1.3	20446
	241	Low		0.4		0.6	2.0	0.3	2.1	0.7	0.2	2.1	0.7		
A-HSA017 0-1'	19	7.4	2.6	5	4	5	153	853	63	1.1	0.2	5	40	1.2	20447
	45	Low		0.2		0.2	1.5	1.1	0.6	1.8	0.1	1.0	1.8		
A-HSA017 6.5'	24	7.9	24.2	7	10	4	603	1239	898	2.5	1.6	38	123	0.8	20448
	177	Low		0.4		0.1	2.7	0.4	2.3	1.1	0.2	1.9	1.4		
A-HSA017 15'	20	7.9	38.2	7	12	10	731	1190	926	2.4	3.7	53	85	0.9	20449
	188	Low		0.5		0.4	3.4	0.4	2.5	1.1	0.4	2.8	1.0		

Saturation Extract Values						SAR	Gravel %		Percent of Sample Passing 2 mm Screen					USDA Soil Classification	Lab No.
									Sand						
Ca meq/L	Mg meq/L	Na meq/L	K meq/L	B ppm	SO_4 meq/L		Coarse 5 - 12	Fine 2 - 5	Very Coarse 1 - 2	Coarse 0.5 - 1	Med. to Very Fine 0.05 - 0.5	Silt .002-.05	Clay 0-.002		
7.4	1.5	3.0	0.9	0.30	4.7	1.4	0.1	0	0.2	0.4	81.1	14.8	3.3	Loamy Sand	20444
34.0	57.3	255.0	7.0	1.59	148.0	37.7	0	0.1	0.2	0.4	62.1	22.5	14.7	Sandy Loam	20445
16.0	42.1	274.0	4.0	1.08	15.6	50.8	0.1	0.2	0	0.4	40.3	38.5	20.7	Loam	20446
17.9	3.3	8.1	1.2	0.36	11.9	2.5	0	0	0.2	0.5	86	9.8	3.3	Loamy Sand	20447
20.5	44.8	197.0	6.8	0.64	94.4	34.5	0	0	0.2	0.2	50.3	28.5	20.7	Loam	20448
27.1	78.4	356.0	7.8	1.98	76.6	49.0	0	0.1	0	0.2	42.5	40.5	16.7	Loam	20449

Sufficiency factor (1.0=sufficient for average crop) below each nutrient value. N factor based on 200 ppm constant feed. SAR = Sodium adsorption ratio. Half Saturation %=approx field moisture capacity. Nitrogen(N), Potassium(K), Calcium(Ca) and Magnesium(Mg) by sodium chloride extraction. Phosphorus(P) by sodium bicarbonate extraction. Copper(Cu), Zinc(Zn), Manganese(Mn) & Iron(Fe) by DTPA extraction. Sat. ext. method for salinity (ECe as dS/m),Boron (B), Sulfate(SO_4), Sodium(Na). Gravel fraction expressed as percent by weight of oven-dried sample passing a 12mm(1/2 inch) sieve. Particle sizes in millimeters. Organic percentage determined by Walkley-Black or Loss on Ignition.

* LOW , SUFFICIENT , HIGH

WRA Environmental
2169-G E. Francisco Blvd.

San Rafael CA 94901

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www.soilandplantlaboratory.com

Project : Ballona Wetlands

Report No : **12-286-0052**
Purchase Order :
Date Recd : 10/12/2012
Date Printed : 10/19/2012

COMPREHENSIVE SOIL ANALYSIS

Sample Description - Sample ID	Half Sat % / TEC	pH / Qual Lime	ECe dS/m	NO_3-N ppm	NH_4-N ppm	PO_4-P ppm	K ppm	Ca ppm	Mg ppm	Cu ppm	Zn ppm	Mn ppm	Fe ppm	Organic % dry wt.	Lab No.
				Sufficiency Factors											
A-HSA018 0-1'	31	7.3	2.9	12	3	9	486	2512	383	3.2	1.5	16	47	2.5	20450
	159	Low		0.2		0.2	2.2	1.0	1.1	1.5	0.2	0.9	0.6		
A-HSA018 17-19'	27	7.8	29.1	6	15	13	364	1635	1105	2.2	5.2	49	155	2.6	20451
	172	Low		0.4		0.4	1.7	0.6	2.9	1.0	0.6	2.6	1.8		

Saturation Extract Values						SAR	Gravel %		Percent of Sample Passing 2 mm Screen					USDA Soil Classification	Lab No.
									Sand						
Ca meq/L	Mg meq/L	Na meq/L	K meq/L	B ppm	SO_4 meq/L		Coarse 5 - 12	Fine 2 - 5	Very Coarse 1 - 2	Coarse 0.5 - 1	Med. to Very Fine 0.05 - 0.5	Silt .002-.05	Clay 0-.002		
18.5	6.2	9.7	1.7	0.80	17.3	2.8	0.4	0.3	0.8	1.0	44.9	32.5	20.7	Loam	20450
43.5	72.7	227.0	3.5	1.08	78.2	29.8	0	0.2	0.2	0.8	45.7	30.5	22.7	Loam	20451

Sufficiency factor (1.0=sufficient for average crop) below each nutrient value. N factor based on 200 ppm constant feed. SAR = Sodium adsorption ratio. Half Saturation %=approx field moisture capacity. Nitrogen(N), Potassium(K), Calcium(Ca) and Magnesium(Mg) by sodium chloride extraction. Phosphorus(P) by sodium bicarbonate extraction. Copper(Cu), Zinc(Zn), Manganese(Mn) & Iron(Fe) by DTPA extraction. Sat. ext. method for salinity (ECe as dS/m),Boron (B), Sulfate(SO_4), Sodium(Na). Gravel fraction expressed as percent by weight of oven-dried sample passing a 12mm(1/2 inch) sieve. Particle sizes in millimeters. Organic percentage determined by Walkley-Black or Loss on Ignition.

* LOW , SUFFICIENT , HIGH

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San Jose Office
October 30, 2012
Report 12-289-0055

WRA Environmental
2169-G E. Francisco Blvd.
San Rafael, CA 94901

Attn: Tanner Harris

RE: Ballona Wetlands

Background

The samples received October 12, 2012 were identified as representing buried subsoils that are scheduled to be used for tidal marsh and upland planting. Due to the tidal marsh location and waterlogged (reduced) nature of the soils an acid-base accounting (ABA) measurement was performed. This analysis was performed to determine the potential for a drop in pH as the sulfur is oxidized due to exposure to oxygen. The calculation and ABA results are presented below. The raw data of the analyses are attached.

Analytical Results and Comments

To determine the ABA of a material the neutralization potential (NP) and acid-producing potential (AP) are measured. The ABA is determined as tons of Calcium Carbonate per 1000 tons of material (Tcce/kT). The NP is presented in the raw data in these units. However, the total sulfur is presented in parts per million (ppm) and must be converted to percent sulfur and then must be converted to calcium carbonate equivalents using the atomic mass of sulfur and calcium carbonate.

ABA = NP + AP   AP = -% S * 31.25   ppm S = ppm/10,000 = %S

If the ABA is negative (<-20 Tcce/kT), there is a potential for the soil to turn very acidic and a neutralizing amendment should be applied. However, if the ABA is positive (>20 Tcce/kT), then the soil pH changes will be buffered by the presence of calcium carbonate lime and not significantly decrease over time as the sulfur is oxidized. Between -20 and 20 Tcce/kT it is unknown whether the material is acid producing.

Sample	ABA (Tcce/kT)
A-HSA-016 (8')	132.6
A-HAS-016 (17')	91.16
A-HAS-017 (6.5')	203.0
A-HAS-017 (15')	95.00
A-HAS-018 (17-19')	88.41

None of the samples appear to have the potential to drop to a very acidic range. The calcium carbonate lime present will likely neutralize any acid formation that occurs. In the previous report (12-286-0052), these samples were shown to have moderately alkaline pH values. Most native plants do have some tolerance for alkalinity, but for those on the plant list that are more alkaline sensitive it is not recommended to install those in this material.

If we can be of any further assistance, please feel free to contact us.

Meagan Hynes, Ph.D., APSS
Emailed 6 pages: harris@wra-ca.com

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Report Number
12-289-0055

Account Number
00432

Send To: WRA Environmental
2169-G E. Francisco Blvd.

San Rafael , CA 94901

Project : Ballona Wetlands

Purchase Order :
Report Date : 10/30/2012
Date Received : 10/15/2012

REPORT OF ANALYSIS

Date Sampled :

Lab Number: 67118
Sample Id : A-HSA-016 (8')

Analysis	Result	Quantitation Limit	Method	Date and Time Test Started	Analyst
Neutralization Potential , Tcce/kT	142	2.6	EPA-600/2-78-054/3.2.3	10/24/2012 11:19	AYG
Total Sulfur , mg/Kg	3000	5.00	SW-6010B	10/25/2012 12:19	JTR
Fizz Rating ,	Strong		EPA-600/2-78-054/3.2.3	10/24/2012 11:19	AYG
Pyritic Sulfur , %	<0.100	0.100	EPA-600/2-78-054/3.2.6	10/24/2012 11:19	AYG

Method Reference:
Field and Laboratory Methods Applicable to Overburdens and Minesoils
USEPA, SW-846, Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods, 3rd Ed. Current Revision
Comments:

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REPORT OF ANALYSIS

Date Sampled :

Lab Number: 67119
Sample Id : A-HSA-016 (17')

Analysis	Result	Quantitation Limit	Method	Date and Time Test Started	Analyst
Neutralization Potential , Tcce/kT	95.0	2.6	EPA-600/2-78-054/3.2.3	10/24/2012 11:19	AYG
Total Sulfur , mg/Kg	1230	5.00	SW-6010B	10/25/2012 12:21	JTR
Fizz Rating ,	Strong		EPA-600/2-78-054/3.2.3	10/24/2012 11:19	AYG
Pyritic Sulfur , %	0.110	0.100	EPA-600/2-78-054/3.2.6	10/24/2012 11:19	AYG

Method Reference:
Field and Laboratory Methods Applicable to Overburdens and Minesoils
USEPA, SW-846, Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods, 3rd Ed. Current Revision

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REPORT OF ANALYSIS

Date Sampled :

Lab Number: 67120
Sample Id : A-HSA-017 (6.5')

Analysis	**Result**	**Quantitation Limit**	**Method**	**Date and Time Test Started**	**Analyst**
Neutralization Potential , Tcce/kT	215	2.6	EPA-600/2-78-054/3.2.3	10/24/2012 11:19	AYG
Total Sulfur , mg/Kg	3740	5.00	SW-6010B	10/25/2012 12:23	JTR
Fizz Rating ,	Strong		EPA-600/2-78-054/3.2.3	10/24/2012 11:19	AYG
Pyritic Sulfur , %	<0.100	0.100	EPA-600/2-78-054/3.2.6	10/24/2012 11:19	AYG

Method Reference:
Field and Laboratory Methods Applicable to Overburdens and Minesoils
USEPA, SW-846, Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods, 3rd Ed. Current Revision
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Report Date : 10/30/2012

Date Received : 10/15/2012

REPORT OF ANALYSIS

Date Sampled :

Lab Number: 67121

Sample Id : A-HSA-017 (15')

Analysis	Result	Quantitation Limit	Method	Date and Time Test Started	Analyst
Neutralization Potential , Tcce/kT	97.4	2.6	EPA-600/2-78-054/3.2.3	10/24/2012 11:19	AYG
Total Sulfur , mg/Kg	668	5.00	SW-6010B	10/25/2012 12:25	JTR
Fizz Rating ,	Strong		EPA-600/2-78-054/3.2.3	10/24/2012 11:19	AYG
Pyritic Sulfur , %	<0.100	0.100	EPA-600/2-78-054/3.2.6	10/24/2012 11:19	AYG

Method Reference:
Field and Laboratory Methods Applicable to Overburdens and Minesoils
USEPA, SW-846, Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods, 3rd Ed. Current Revision

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Purchase Order :
Report Date : 10/30/2012
Date Received : 10/15/2012

REPORT OF ANALYSIS

Date Sampled :

Lab Number: 67122
Sample Id : A-HSA-017 (17-19')

Analysis	Result	Quantitation Limit	Method	Date and Time Test Started	Analyst
Neutralization Potential , Tcce/kT	92.1	2.6	EPA-600/2-78-054/3.2.3	10/24/2012 11:19	AYG
Total Sulfur , mg/Kg	1180	5.00	SW-6010B	10/25/2012 12:27	JTR
Fizz Rating ,	Strong		EPA-600/2-78-054/3.2.3	10/24/2012 11:19	AYG
Pyritic Sulfur , %	0.160	0.100	EPA-600/2-78-054/3.2.6	10/24/2012 11:19	AYG

Method Reference:
Field and Laboratory Methods Applicable to Overburdens and Minesoils
USEPA, SW-846, Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods, 3rd Ed. Current Revision
Comments:

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APPENDIX C

INVASIVE PLANT CONTROL METHODS

Appendix C. Control methods for selected invasive plant species at the Reserve (adapted from DiTomaso and Healy 2007a, b).

Acacia (*Acacia cyclops*, *A. longifolia*, *A. retinodes*). Acacia is a woody shrub or tree that is resistant to many herbicides. The most effective method of control for acacia is manual removal of aboveground vegetation; sprouts from the cut stump must be removed until the root system dies. Seedlings must be pulled until the seed bank is exhausted, at least three years.

Giant reed (*Arundo donax*). Manual removal of giant reed is ineffective. Systemic herbicide, such as glyphosate, should be applied to mature plants in late summer to early fall. It is also possible to use the 'cut stump' method on giant reed canes during the spring and summer. Giant reed can resprout through both vegetative and root material; if plants are controlled using the 'cut stump' method, all plant material should be collected and disposed of offsite.

Black mustard (*Brassica nigra*). Black mustard is an annual species that spreads exclusively by seed. Repeated mowing before the plant forms mature seeds can be an effective control method. This species makes a great deal of seed which can survive up to 11 years; continued monitoring and maintenance is recommended for at least 11 years after initial treatment.

Sea-fig (*Carpobrotus chilensis*). Sea-fig is a succulent perennial. The species is shallow-rooted, making hand weeding an effective control method. The species will resprout from vegetative fragments left in contact with the ground, so all material should be collected and disposed of offsite. This species produces viable seed, and vegetative fragments can remain unseen in the soil; continued monitoring and maintenance is recommended for at least three years.

Poison hemlock (*Conium maculatum*). Poison hemlock is an annual species with a deep taproot. Repeated mowing before the plant sets seed (late summer to early fall) can be an effective method of control. This species thrives in recently disturbed soil; caution should be taken to minimize soil disturbances. The seed can remain viable for up to three years; monitoring and maintenance is recommended for at least three years.

Pampas grass (*Cortaderia selloana*). Pampas grass can be killed by cutting the plant below the crown. This is most easily done with a chainsaw or ax. This species thrives in recently disturbed soil, and caution should be taken to minimize soil disturbances.

Red gum (*Eucalyptus camaldulensis*). Red gum is a long-lived tree that can easily resprout after cutting. Mature trees should be cut down or girdled and treated with glyphosate or similar systemic herbicide. Herbicide should be applied to the exposed sapwood to reduce the number of sprouts from the root network. Young trees can be removed by hand. The root network and seeds can remain viable for up to three years; monitoring and maintenance is recommended for at least three years.

Terracina spurge (*Euphorbia terracina*). Terracina spurge is a perennial species that is very difficult to control. It is resistant to most chemical herbicides and is not affected by mowing (underground parts can persist in the soil for up to eight years). A combination of chemical and manual control methods should be used over the course of at least eight years to ensure all the remaining plants and below ground parts are eliminated.

Sweet fennel (*Foeniculum vulgare*). Sweet fennel is a perennial species with a deep taproot. Because it is perennial mowing is not an effective means of control. Fall burning followed by herbicide treatment of new foliage has been shown to control larger stands, although the process can take up to two years. This species thrives in recently disturbed soil, and caution should be taken to minimize soil disturbances. The seed can remain viable for up to three years; monitoring and maintenance is recommended for at least three years.

Crown daisy (*Glebionis coronaria* [*Chrysanthemum coronarium*]). This species is an annual plant which spreads exclusively by seed. Repeated mowing before the plant forms mature seeds can be an effective control method.

Canary ivy (*Hedera canariensis*). Canary ivy is shallow rooted, making hand weeding an effective control method. The species will resprout from vegetative fragments left in contact with the ground, so all material should be collected and disposed of offsite. This species produces viable seed, and vegetative fragments can remain unseen in the soil; continued monitoring and maintenance is recommended for at least three years.

Summer mustard (*Hirschfeldia incana*). Summer mustard is an annual species that spreads exclusively by seed. Repeated mowing before the plant forms mature seeds can be an effective control method. This species makes a great deal of seed which can live up to 11 years; continued monitoring and maintenance is recommended for at least 11 years after initial treatment.

Ngaio tree (*Myoporum laetum*). Ngaio tree is a large shrub or small tree that readily resprouts after cutting. Mature trees should be cut down or girdled and treated with glyphosate or similar systemic herbicide. Herbicides should be applied to the exposed sapwood to reduce the number of sprouts from the root network. Young trees can be removed by hand. The root network and seeds can remain viable for up to three years; monitoring and maintenance is recommended for at least three years.

Tree tobacco (*Nicotiana glauca*). Tree tobacco is a short-lived shrub or small tree. Manual removal of mature plants and seedlings is an effective control method.

Phoenix date palm (*Phoenix canariensis*). Phoenix date palm is a long-lived tree. Manual removal of mature plants and seedlings is an effective control method. This species thrives in recently disturbed soil; caution should be taken to minimize soil disturbances.

Aleppo pine (*Pinus halepensis*). Aleppo pine is a long-lived conifer. Manual removal of mature plants and seedlings is an effective control method for this species.

Castor bean (*Ricinus communis*). Castor bean is a perennial species that can occur as an herbaceous plant or small woody shrub. Manual removal or systemic herbicide application can be effective means of control of this plant. The removal of a larger plant often encourages increased seed germination; care should be taken to maintain the area where any larger tree was removed.

Tumbleweed (*Salsola tragus*). Tumbleweed is an annual herb that spreads by seed. One of the most effective methods of control for tumbleweed is to cut the young plants immediately above the cotyledons. Treatment it must be timed to ensure plants are not able to produce viable seed. Seeds remain viable for up to two years; maintenance and monitoring should be continued for up to two years.

Brazilian peppertree (*Schinus terebinthifolius*). Brazilian peppertree is a woody shrub. Roots of the Brazilian peppertree will readily resprout. Mature trees should be cut down or girdled and treated with glyphosate or similar systemic herbicide. Herbicides should be applied to the exposed sapwood to reduce the number of sprouts from the root network. Young trees can be removed by hand. The root network and seeds can remain viable for up to three years; monitoring and maintenance is recommended for at least three years.

Saltcedar (*Tamarix ramosissima*). Saltcedar is a woody shrub to small tree. Cut stumps will readily resprout; mature trees should be cut down or girdled and treated with glyphosate or similar systemic herbicide. Herbicides should be applied to the exposed sapwood to reduce the number of sprouts from the root network. Young trees can be removed by hand. Seeds remain viable for only five weeks, but mature plants produce many seeds. Seedlings should be pulled as soon as they are found to prevent further infestation.

APPENDIX D

INVENTORY OF BASIC BEST MANAGEMENT PRACTICES

Appendix D. Inventory of Basic Best Management Practices.

The following Best Management Practices are recommended for implementation during the restoration at the BWER. The list presented below primarily addresses measures designed to protect water quality. The list is intended to serve as a guide only and is not intended to be an exhaustive list of all best management practices to be implemented. Additional best management practices may be appropriate and/or may be required by the regulatory agencies. For additional best management practices see Cal-IPC (2012a, b), Environmental Protection Agency (2000), and Caltrans (2003), among others.

- The construction, staging, and access areas should be clearly marked with orange plastic, or similar, fencing and no work should be conducted outside of this area.

- A qualified biologist should train all project staff regarding habitat sensitivity, identification of listed species, and required best management practices before the start of construction. The training should cover the general measures being implemented to conserve the species as they relate to the project, penalties for noncompliance, and species ecology with key identifying features. A factsheet or other supporting materials containing this information should be prepared and distributed to all project staff. Upon completion of training, employees should sign a form stating that they attended the training and understand all of the conservation and protection measures. The training should be conducted in languages other than English, as appropriate, for workers who do not speak or understand English.

- A Spill Prevention and Control Plan should be developed for work within and adjacent to the aquatic habitats. The Spill Prevention and Control Plan should contain measures to prevent and control potential spills of hazardous materials associated with mechanical equipment (e.g., oil, gas, hydraulics, etc.), as well as measures to minimize contact with the stream bed, such as the use of work pads. The plan and materials necessary to implement it should be accessible on-site.

- All fueling, maintenance, and staging of equipment and vehicles should occur away from wetlands and outside of active stream channels, above the top of the bank.

- Heavy equipment should be checked daily for leaks. Equipment with leaks should not be used until leaks are fixed.

- Any leaks, drips, or spills should be immediately controlled to prevent entry into waterways, ditches, or other tributaries to waterways.

- At a pre-construction meeting, all workers should be informed of the importance of preventing accidental spills and the procedure, protocol, and required measures to be followed if an accidental spill or construction site discharge enters waterways, ditches, or other tributaries to waterways.

- All workers should ensure that food scraps, paper wrappers, food containers, cans, bottles, and other trash from the project area are deposited in covered or closed trash containers. The trash containers should not be left open and unattended overnight.

- If water is present in streams or channels during construction, water diversion should be implemented following procedures approved by the USFWS and the RWQCB and should be constructed using clean and contained material such as sandbags filled with gravel and wrapped in plastic, an inflatable coffer dam system, or similar materials.

- Tightly woven fiber netting, straw, or similar material should be used for erosion control after completion of construction activities and/or before the onset of a rain event. The material used should be designed to avoid trapping of wildlife species which might be present in the project area during or after construction. Plastic monofilament matting should not be used for erosion control.